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The Pathology of Brain Tumors and Its Relationship to Roentgenologic Diagnosis[1]

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THE TITLE OF this part of the symposium on brain tumors does not question the existence of a relationship between pathology and roentgenologic diagnosis; it is rather a statement of fact. This is stimulating to the imagination, yet is full of danger for any who might incline toward over-enthusiasm. The relative situations to be discussed are the possibilities, perhaps occasionally probabilities, of pathologic diagnosis when the radiologist possesses certain clinical and roentgenographic information. An attempt will be made to point out the possible pathological reasons for some of the shadows recorded on the x-ray film.

In 1879 Macewen (4) successfully removed a brain tumor from the frontal lobe, the first operation of this kind on record. The next eighteen years of neuro-anatomical and neurophysiological endeavor culminated in an event in Italy which, though unheralded at the time, was comparable in its implications to the original surgical attack on this disease. In 1897, just two years after Roentgen discovered the x-ray, Obici and Bollici (5) first recorded the radiographic demonstration of an intracranial tumor (Fig. 1). In the four and one-half decades which have followed, the labor of anatomists, physiologists, pathologists, clinicians, surgeons, and radiologists has brought us to a level where we can attempt a correlation between two highly specialized scientific fields.

First to be considered is the *supratentorial group* of brain tumors.

SUPRATENTORIAL TUMORS

Gliomas

Gliomas constitute between 40 and 50 per cent of all tumors of the central nervous system (1, 3). The modern pathological concept of these growths has its roots in the monograph by Bailey and Cushing (6), published in 1926. With but minor amendments, their classification remains the most generally accepted. It is based on our present ideas of the embryology of glia and on the structural variations peculiar to neoplasms in which the various stages of glial metamorphosis appear.

Of the supratentorial group, *glioblastoma multiforme* is by far the most common, constituting approximately 43 per cent of the gliomas in this region. It occurs most commonly during the fourth, fifth, and sixth decades. The average duration of symptoms before examination is only six months; sometimes it is less than two weeks. These growths may occur any-

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where in the brain, apparently commencing in the white matter and spreading rapidly, infiltrating the adjacent tissue. They spread to the opposite hemisphere by way of the corpus callosum or extend deeply to the ganglionic masses and midbrain. It is a clinical impression that the most frequent localization is the vicinity of the junction of the temporal, parietal, and occipital lobes near the head of the fissure of Sylvius. With such rapid proliferation of vessels as well as of glial cells, hemorrhages commonly occur, producing sudden exacerbation of symptoms and signs. Since growth outstrips blood supply, necrosis occurs and cysts are often encountered. Despite the rapidity of growth, calcification is not unusual and even bone formation is encountered from time to time. Marked general edema of the brain, especially in the ipsilateral hemisphere, is the rule.

Astrocytoma, the glioma most common in the central nervous system as a whole, is second among the supratentorial growths, comprising 32 per cent of the gliomas in this region. The average age of this group of patients is roughly ten years less than that of patients who have glioblastoma multiforme, most of them being between twenty and fifty years of age. The duration of symptoms before study averages nearly three years. Any part of the brain may be affected, the incidence of the lesion in each lobe being comparable to the proportionate size of the lobe. Recent work by Busch (7) suggests that most tumors arising primarily in the corpus callosum are of this type, though hemispheral growths of all glial types may traverse this tract to the opposite hemisphere.

Penfield subdivided astrocytomas into the piloid or fibrous variant, the gemistocytic or Nissl's plump astrocyte variant, and the astrocytoma diffusum, principally of protoplasmic astrocytes. These divisions constitute the neoplastic proliferations of the three principal types of astrocytes generally encountered. Large cysts, resulting in part from degeneration of cell processes, are commonly seen in the first two, never in the last—a notation of particular interest to the radiologist.

Astroblastoma comprises 7.5 per cent of cerebral gliomas. Like its more adult relative, it is an infiltrating tumor which may occur anywhere in the cerebrum. It can hardly be said to be peculiar to any age group. Some examples have been slow-growing, others exceedingly rapid. The average duration of symptoms before investigation is slightly more than one year.

Oligodendroglioma outside the cerebral hemispheres has yet to be described incontrovertably. This slowly infiltrating tumor of cells which, numerically, make up so much of the cerebral substance, accounts for but 7 per cent of the cerebral gliomas. Some authorities assert that they have not seen an example of this tumor without calcification demonstrable in the x-ray film. The average age of patients is about thirty years, the average duration of symptoms eleven years (8).

Ependymoma, a tumor comprised of cells arising from the same stem as that producing the lining epithelium of the ventricles and central canal of the cord, constitutes 5 per cent of the cerebral gliomas. The average age of the patients is about thirty years. Their symptoms generally date back somewhat less than a year. As would be expected, most of these tumors are within the lateral ventricles or are attached to them. In our experience, most primary gliomas within the lateral ventricles have been of this type. They have been described, however, without demonstrable connection with any ependyma-lined cavity. When in the ventricle, they are usually attached at but one place and often do not tend to invade surrounding tissues.

To the radiologist all gliomas have much in common. Being tumors of the substance of the brain, all may give general signs of intrinsic cerebral tumefaction. All are more or less infiltrating. None is truly encapsulated, nor has any one of them a gross characteristic which can be said to be strictly peculiar to it.

All of the tumors of the glioma group may come to the surface and may even seed into the subarachnoid space, but focal changes in the skull are rare. Any of them may exhibit calcification. In the astrocytoma, especially of the piloid or gemistocytic type, calcification may be especially dense, well within the body of the hemisphere and may be shell-like in contour, suggesting the partial outline of a cyst. On the basis of mathematical probability, calcification is more suggestive of astrocytoma than of any other type. In the other gliomas, the radiopaque material is usually more nebulous, often being observed only by stereoscopic study.

Pneumographic studies of patients with supratentorial gliomas usually show a generalized as well as a localized ventricular shift because of the more or less pronounced hemispheral edema so commonly associated with any of these lesions. This is especially marked in glioblastoma multiforme. As mentioned before, tumors within

Fig. 1. First known roentgenographic demonstration of an intracranial tumor. Copied from Obici and Bollici: Riv. di pat. nerv. 2: 433–440, 1897.

the lateral ventricles are likely to be ependymomas, though intraventricular projections of other types cannot be called rare. The pneumographic picture of intraventricular tumor of the lateral ventricles should not be confused with tumor invading the opposite hemisphere by way of the corpus callosum, usually glioblastoma multiforme, or with intrinsic glioma of the corpus callosum, most commonly an astrocytoma.

From time to time the neurosurgeon will encounter an intracerebral cyst during the process of attempted ventriculography. He is usually aware of this circumstance because of the character of the fluid, which is xanthochromic or hemorrhagic, with increased viscosity. The x-ray film will show the air filling the cyst. Under such circumstances, glioblastoma multiforme or astrocytoma of the fibrous or gemistocytic type is the most probable underlying lesion.

Meningeal Fibroblastoma

Meningeal fibroblastoma (meningioma, arachnoidal fibroblastoma, dural endothelioma, dural sarcoma, psammoma) is an encapsulated tumor probably arising from nests of arachnoidal cells, seen with particular frequency in association with or near pacchionian granulations.

Of Cushing's series (3) of 2,023 intracranial tumors, meningiomas constituted 13.4 per cent. Eighty-six per cent of all meningiomas lie above the tentorium (2). These growths occur principally in persons between thirty and sixty years of age. The ratio between men and women is 2 to 3. Meningiomas are said to be rare in the Negro (2). Generally the rate of growth is slow; the duration of symptoms may be a matter of weeks or up to twenty years, but the average is from one to five years. These tumors may occur anywhere, but are most frequently seen in the parasagittal region, beneath the convexity of the skull, and along the sphenoidal ridge. The tumor never (1), or at least rarely (2), passes the pial barrier to invade the substance of the brain, but commonly invades and alters the dura and adjacent skull. To accomplish this, cells enter the haversian canals of the skull, where they produce a variety of changes of interest to the radiologist. A second noteworthy observation is that the blood supply of these growths comes chiefly from the dura; hence demonstrable abnormalities in vascular channels of the skull frequently are associated.

From the roentgenographic standpoint the pathological picture of meningeal fibroblastoma resolves itself into 5 subdivisions related to the pathological subtypes submitted by Cushing and Eisenhardt.

In Type I (Fig. 2) there have been invasion and destruction of the overlying skull so that there is a thickening of bone about a central core of complete neoplastic osseous destruction. This is an unusual picture, but the differential diagnosis is usually not a serious problem.

Type II (Fig. 3) is representative of that group in which the arachnoidal cells have traversed the dura, invaded the canals of the skull, penetrated the outer table as well, and spread out beneath the galea. In the roentgenogram the skull appears worm-eaten but there is preservation of sufficient bony framework to function anatomically as cranium. In microscopic section, strands of tumor cells interlace with spicules of bone in the same field.

Type III (Fig. 4) shows simple proliferative reaction of the two tables to the neoplastic inroads into the haversian canals. The fusiform thickening with perpendicular bony spicules and radiographic preservation of the original tables constitutes the pathologic picture.

Type IV. At times the inner table alone may respond to the adjacent meningeal tumor (Fig. 5). In our experience, this reaction has occurred in the base of the skull. It has been noted particularly near the mid-line of the anterior fossa. These homogeneous osteoma-like projections may be ivory-hard. The demonstration of tumor cells within the reacting tissue itself is difficult.

In Type V (Fig. 6) the roentgenogram shows no bony thickening. At most,

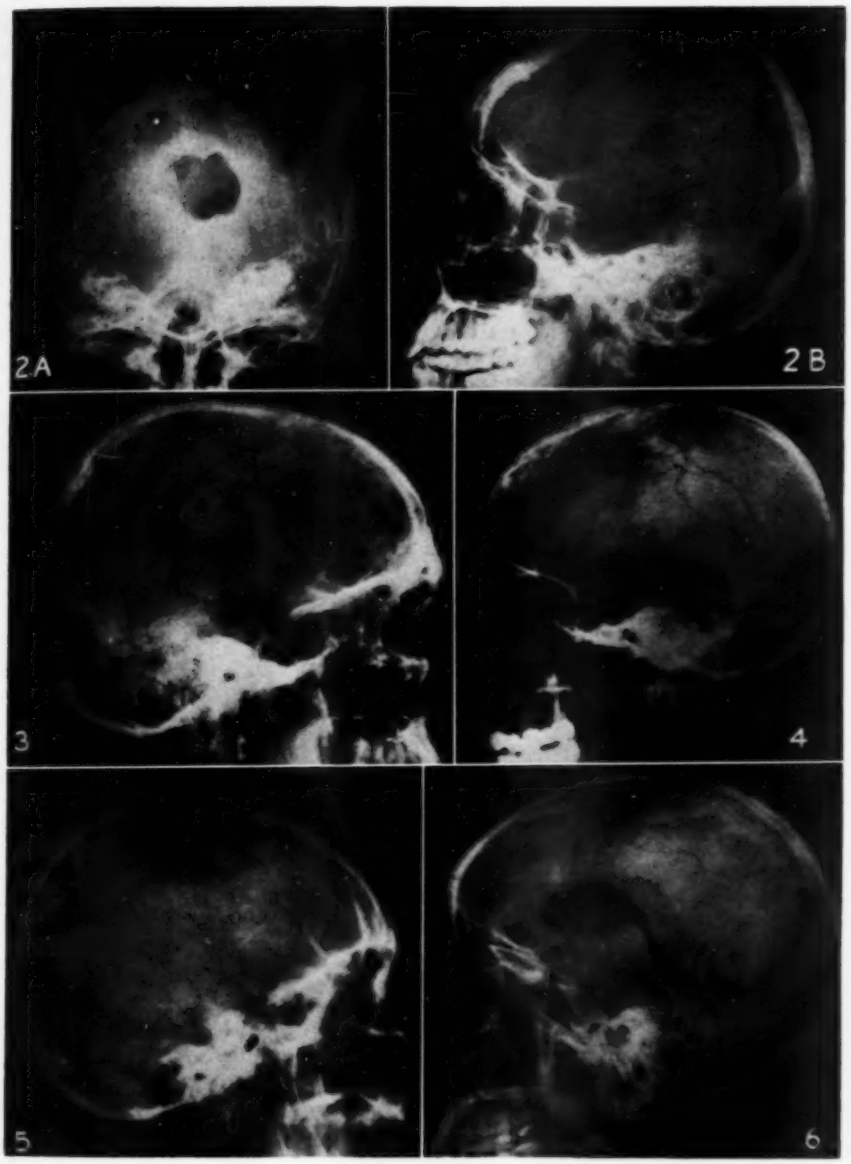

Fig. 2. Meningeal fibroblastoma, Type I. Anteroposterior and lateral views, showing the core of destruction of bone in the center of the invaded area of the skull.

Fig. 3. Meningeal fibroblastoma, Type II. The worm-eaten effect is characteristic of the general infiltration of the tumor through the skull to form a plaque beneath the galea. Note the vascular markings as well.

Fig. 4. Meningeal fibroblastoma, Type III. Proliferative reaction in the tables of the skull following invasion of the haversian canals by the tumor. Note that the original position of the tables can still be seen.

Fig. 5. Meningeal fibroblastoma, Type IV. Homogeneous bony projection of the inner table arising from the olfactory groove and associated with a tumor in this location.

Fig. 6. Meningeal fibroblastoma, Type V. The only bony change is the channel gouging the skull in the direction of the growth. Note the sectional displacement of the ventricle characteristic of the pneumographic picture of the meningeal fibroblastoma group as a whole.

there is but a deepened or prominent vascular channel. Type V comprises nearly half of the meningeal fibroblastomas. In this group, even when the vascular channels are normal, the radiologist can still find a clue to the type of neoplasm present. Certainly the history and clinical findings which led to the original request for roentgen examination will spur the neurologist and his consultant to do pneumographic studies. The extracerebral position of meningeal tumors results in minimal edema of the hemisphere. Parasagittal meningeal tumors obstructing venous drainage have been seen to produce generalized hemispheral edema. These, however, are exceptional. Focal ventricular distortion is rare; usually there is displacement of an entire section of the ventricular system. This may vary from slight depression of the roof of the lateral ventricle produced by the parasagittal tumor to the gross displacement by the giant tumors still encountered all too often.

Miscellaneous Supratentorial Tumors

With the commoner supratentorial tumors, several miscellaneous types of neoplasm must be considered. First is the group about the sella turcica. Roentgenologists early recognized the striking changes in the sella turcica produced by intracranial growths of all types, but particularly by the pituitary tumors. *Chromophobe adenomas*, generally the largest of these, appear in the third to the fifth decade of life, are characterized clinically by the hypopituitary syndrome and by signs of pressure on adjacent structures, most commonly the optic nerves, producing bitemporal hemianopsia. In late cases the tumor may cause signs of pressure on the floor of the third ventricle or may fill the cisternae interpedunculares and pontis, producing clinical findings. The x-ray picture is that of direct pressure on the sella, especially the dorsum and floor. There likewise may be undercutting of the tuberculum sellae, with increase of the sella's sagittal dimension. In an adult skull devoid of the characteristics of acromegaly, this picture suggests chromophobe adenoma.

Eosinophilic adenoma produces the well recognized syndrome of acromegaly. This tumor appears in patients of the same age group as does the chromophobe adenoma, or one slightly older. Structures other than the adjacent optic nerves are seldom involved. The associated large frontal sinuses, thick mandible, and large hands and feet are well recognized by the roentgenologist and lead to a diagnosis of the pathological type even in the absence of sellar enlargement.

Basophilic adenoma has no characteristic roentgenographic appearance.

The third type of tumor associated with the sella is the *Rathke pouch cyst* or *craniopharyngioma*. As the pharyngeal anlage of the anterior lobe of the pituitary body migrates into position, cell rests are left along its embryonic course. A common site is about the pituitary stalk as it connects with the gland proper. Tumors or cysts originating from these rests usually appear by the age of thirty and often are seen before sexual development has occurred. The frequent result of the ensuing hypopituitarism is the familiar infantilism with a skeletal age less than the chronological age, visual disturbance, and often signs of hypothalamic or hippocampal neoplasia.

Calcium is deposited in a high percentage of these epithelial tumors, sometimes as a fairly dense shell outlining the cystic cavities comprising the bulk of the tumor.

In a person whose skeletal age is definitely less than his chronological age, or who is undoubtedly infantile in development, a roentgen picture of an expanded sella turcica with more or less erosion of the dorsum suggests this type of growth. The additional presence of calcium in the suprasellar region is almost pathognomonic.

Aside from gliomas of the third ventricle and sellar or suprasellar growths, a benign lesion peculiar to the anterior portion of this ventricle should be mentioned, namely, *benign cyst of the third ventricle*. These cystic growths containing gelatinous ma-

terial extend from the roof of the third ventricle into that cavity. Sometimes called paraphysial tumors because of their presumed relationship with this embryonic organ which develops from the roof of the ventricle in the lower vertebrates, they are lined by a thin membrane which often has been deprived of its cells. Their clinical characteristics rest on their tendency to block the foramina of Munro, producing headache and hydrocephalus. In the pneumogram, the cyst may be outlined by gas posterior to it in the third ventricle.

The relationship of *pineal tumors* to radiologic diagnosis is chiefly on a localizing basis. A neoplasm at the back of the third ventricle, especially one with calcium demonstrable in the x-ray film, obviously suggests this pathological diagnosis.

The optic nerve may be the site of a glioma; its sheath may give rise to a meningeal fibroblastoma. In either instance there is generally unilateral blindness and at times unilateral proptosis. There is characteristic dilatation of the optic foramen on the affected side.

Angiomas constitute slightly less than 2 per cent of intracranial tumors. For the roentgenologist their principal characteristic is a tendency to deposit calcium in the walls of the vessels and surrounding tissues. On the x-ray film this may show up as parallel streaks of radiopaque material. Should the patient bear a congenital nevus or port-wine mark on the face, or should a bruit be heard, the probability of angioma is greatly increased.

Cholesteatomata or epidermoid cysts may appear wherever embryonic infolding of ectoderm potentially leaves viable cells where their proliferation will result in cystic collections of the débris of epithelial metabolic activity. No characteristic x-ray picture of the intracranial epidermoid or dermoid has been observed. In the skull, however, these tumors present a punched-out appearance with an irregular thickening of the edge somewhat resembling that seen in meningiomas of Type I. They are seen in the outer angle of the orbit or above the mastoid region.

SUBTENTORIAL TUMORS

Gliomas

Medulloblastoma, the most common of the subtentorial gliomas, and likewise the most common of all tumors of this region in childhood, is noted for its rapid growth, its friability, its tendency to seed throughout the subarachnoid space, including the lateral ventricles, and its sensitivity to radiation therapy. The average duration of symptoms when these patients are first seen is only five months. Although the tumor is primarily one of childhood, enough examples have appeared in the older age groups to raise the average age to the latter half of the second decade. The growth blocks the cerebral fluid channels and invades the cerebellar centers, accounting for the usual clinical findings. It has long been recognized that this tumor usually presents in the mid-line and in the roof of the fourth ventricle. Various authors have sought to attribute these neoplasms to cell rests representing errors in the migration of the cells of the external granular layer in this region. On the other hand, Raaf (9) recently presented impressive evidence that these growths arise from cell rests frequently seen in the vicinity of the embryonic germinal bud. He demonstrated abnormal collections of cells in this region dorsal to the fourth ventricle in over 20 per cent of the specimens examined. When a medulloblastoma has been seen early enough to allow an opinion as to its site of origin, it has generally pointed to this region.

Next most frequent is *astrocytoma*. Most of these tumors are of the piloid or fibrous type. Often they contain large cysts filled with yellow, easily coagulable fluid probably resulting at least in part from the degeneration of astrocyte fibers. On one side of the cyst is usually found a small cellular mass, the so-called mural nodule, which contains the active portion of the tumor. This nodule is of especial importance to the neurosurgeon because its extirpation is so essential to the successful treatment of this particular glioma. These

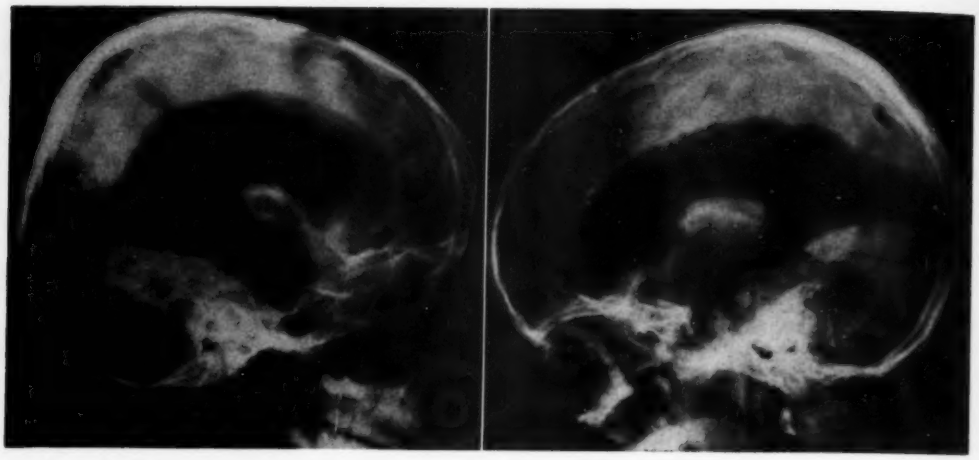

Fig. 7 (left). Pneumogram showing forward displacement of the dilated aqueduct of Sylvius in a patient with medulloblastoma.
Fig. 8 (right). Pneumogram showing ependymoma arising from the floor of the fourth ventricle.

growths lie with equal frequency in the cerebellar hemispheres or the mid-line. Symptoms average nearly three years in duration before aid is sought. The mean age of these patients is twenty-two years.

Cerebellar ependymoma often arises from the floor of the fourth ventricle, filling that cavity and projecting through the foramen of Magendie to enclose the lower medulla and upper portion of the cervical cord. The age group is the same as for the cerebellar astrocytoma, though a calcified tumor of this type was encountered in a child not yet four years of age. The average duration of symptoms before treatment is about one year.

The fourth type is the *polar spongioblastoma*, the most frequent of the so-called pontine tumors. The average age of patients with this tumor is eleven years. Although the cell is fairly young, the tumor is among the less malignant of the gliomas and the speed of growth is moderate. Cystic degeneration has been seen.

In roentgenograms it is difficult to observe calcification in lesions of the posterior fossa because of the interfering mastoid processes and air cells. Hydrocephalus and other evidences of increased intracranial pressure are commonly observed. In most cases ventriculography yields valuable clues as to the pathological diagnosis. When the aqueduct and upper part of the fourth ventricle are displaced forward (Fig. 7), the tumor must arise posteriorly; it is then most commonly a medulloblastoma if the patient is a child, or an astrocytoma if the patient is older. If the ventricle is pushed forward and to one side, further weight is added to the diagnosis of astrocytoma, since this tumor is much more common in the hemispheres. When there is evidence of a tumor arising from the floor of the fourth ventricle (Fig. 8), the possibility of an ependymoma is strong. A smoothly outlined retrograde curve of the floor of the fourth ventricle with widening of the space between this floor and the cisterna pontis suggests a tumor of the pons, often a polar spongioblastoma (Fig. 9).

Any tumor of the fourth ventricle may obstruct the aqueduct completely. There is a certain group of patients, however, usually children at puberty or younger, who have had large heads from infancy, possibly some evidence of a slowly progressive hydrocephalus, but no other signs of cerebellar tumor. Dilatation of the lateral ventricles and third ventricle with failure to visualize all or most of the aqueduct will be noted. Only by superimpos-

ing the encephalograms on the ventriculograms can the fourth ventricle be seen; it will not be dilated. Sometimes this combined procedure is not practicable. Under such circumstances, gliosis of the aqueduct of Sylvius must be considered. Authorities differ as to whether this condition should be regarded as a slowly growing neoplasm or a progressive gliosis. Pathological evidence points to progressive proliferation of astrocytes or ependymal cells, or both. The ependymal lining of the aqueduct has been partially destroyed and that channel broken into minute canals by bridges of the glial cells. Most of the canals are lined by ependyma but in some this is incomplete. With such a reduction in size of this important channel, any malady can produce an exacerbation of signs and symptoms, which may become irreversible. Pneumography itself assumes increased hazards in patients with this condition.

Perineurial fibroblastoma is the name given to a group of encapsulated tumors arising from the sheaths of nerves in the craniospinal cavity. These are particularly prone to involve the eighth nerve, often arising within the porus acusticus, with resulting dilatation of this opening, progressive changes in both vestibular and cochlear divisions of the eighth nerve, and eventual involvement of the seventh nerve and any other which may lie in the path of progress of the particular growth. These tumors are usually more or less cystic. They may remain small or grow to tremendous size. They seldom, if ever, invade the central nervous system. Such growths affect persons in the third, fourth, and fifth decades, and symptoms usually have been present from six months to two years. This is the usual type of growth referred to as cerebellopontine angle tumor. When such a tumor is suspected, it has become traditional to demonstrate by devious projections the comparative enlargement of the correctly lateralized internal auditory meatus. In our experience, unless there is striking erosion, such a procedure may cause more trouble than it prevents. In many patients with proved tumor no difference can be demonstrated. The clinical findings may be so definite that pneumography is not necessary. When pneumography is used, the displacement of the fourth ventricle and aqueduct laterally to the opposite side may be demonstrated.

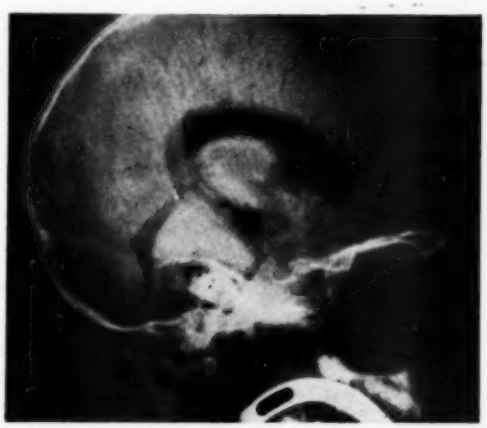

Fig. 9. Pneumogram showing generalized backward displacement of the floor of the fourth ventricle in polar spongioblastoma of the pons.

OTHER INTRACRANIAL GROWTHS

Chordoma is the name given to a group of neoplasms arising from remnants of the notochord. In the skull these are confined to the basiocciput and basisphenoid. Growing slowly over a period of several years, these tumors may appear predominantly within the skull or may spread into the nasopharynx. In the former instance the cranial nerves are affected progressively as they lie in the path of the advancing tumor. Usually the pial barrier is not passed. Those tumors advancing into the nasopharynx may be seen in laryngoscopic examination. Some examples have involved the dorsum sellae and sphenoid sinuses, producing many of the signs and symptoms of pituitary adenoma. X-ray demonstration of erosion of the basiocciput and basisphenoid or pneumographic demonstration of an intracranial mass arising from the clivus strongly suggests chordoma when the clinical findings are compatible.

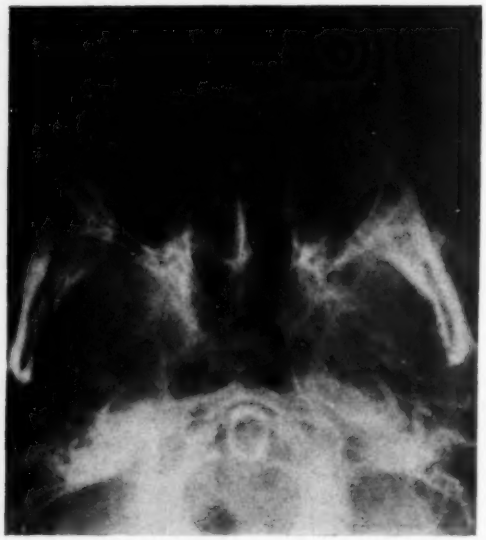

Fig. 10. Metastatic tumor in the base of the skull eroding the bone in the region of the gasserian ganglion The primary tumor was in the breast, which was removed five years previously.

Tumors of the lung, breast, and kidney are particularly likely to metastasize to the brain and skull. As the internal carotid artery is the principal route from the body to the head, it is to be expected that these metastatic cells should reach the cranium often by this means. The internal carotid artery has no branches from the place where it is formed by the bifurcation of the common carotid until it enters the cranium. As it takes an S-shaped course at the point of emergence, it gives off tiny branches to the gasserian ganglion, the sphenoid bone, and the adjacent meninges. This anatomical situation combines with the biological predilection of the tumors mentioned to make this region a common site for metastatic growths (Fig. 10). The usual symptom is pain in one or more divisions of the fifth nerve. Erosion of the base of the skull in this vicinity usually suggests the diagnosis.

A favorite location for *intracranial aneurysm* is the internal carotid artery between the carotid canal and the point of its division into the anterior and middle cerebral arteries. The etiological factor may be trauma, hypertension, congenital defect, or a combination of any of these. The symptoms of headache, visual disturbance, and palsies of the extra-ocular muscles may be progressive or may be marked by exacerbations and remissions. A bruit is often present. Should the aneurysm lie partly within the intra-osseous carotid canal, there may be erosion of the base similar to that seen in metastatic tumors. The diagnostic proof positive, aside from actual exposure of the region and direct observation of the lesion, is the demonstration of the vascular fault by arteriography. This procedure requires complete co-operation between those interested in neurology and those whose field is radiology. Perhaps it is fitting that, with it, we close this discussion of the relation between the pathology of brain tumors and roentgenologic diagnosis.

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Reliability of Brain Tumor Localization by Roentgen Methods[1]

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TUMORS ARISING within the cranial cavity represent no more than 5 per cent of the neoplasms reported during a four-year period by the Cancer Committee of the University of Michigan (1). Although they occur with relative infrequency, they are nevertheless an important group because they present unusually difficult problems of diagnosis and treatment.

The specialized roentgenologic technics which have been developed for use in attempting to solve some of these problems are of very real assistance and their worth has been duly acknowledged by neurologists and neurosurgeons. In 1935 we published an analysis of three years' experience with such methods (2), describing their efficiency in providing reliable information regarding the anatomical location of 190 consecutively encountered brain tumors. Over and above their ability to localize tumors, roentgenological methods of examining the cranium and its contents have many useful applications, none of which, however, lends itself so readily to critical evaluation.

The material presented in the original report, together with data collected from the records of brain tumor patients encountered during the past seven years, has been subjected to re-study in order to compare the earlier findings with observations based upon a longer period of experience and a broader distribution of tumor types.

SELECTION AND TABULATION OF TUMOR DATA

Case material treated in the present analysis consists of *all* examples of intracranial tumor encountered at the University Hospital which meet the following stipulations:

1. Established diagnosis of brain tumor recorded during the ten-year period July 1, 1931–June 30, 1941
2. Actual site of tumor determined by craniotomy or autopsy
3. Tumor tissue available for microscopic examination
4. Prior x-ray examination of the skull or brain

It was found that the records of 565 patients conformed to these imposed criteria.

Nine items of recorded information regarding each of these patients were tabulated, in the following sequence:

1. Registration number
2. Sex
3. Age
4. Histological identity of tumor
5. Proved location of tumor
6. Means by which locality was verified
7. Localizing accuracy of routine skull examination
8. Localizing accuracy of encephalographic examination
9. Localizing accuracy of ventriculographic examination

This material, arranged according to Bailey's classification of brain tumors (3) and in anatomical order of tumor site within each minor subdivision, is presented for purposes of reference in Table I. From this lengthy listing, consolidated figures have been gathered to show incidence of individual tumor types (Table II). Mechanical tabulating equipment was used to advantage in locating and analyzing record material.

Brain tumors studied by x-ray methods and later verified have been accumulating at a relatively constant rate: 63.3 for each of the first three years, 53.5 per year for the remainder of the ten-year period.

[1] From the Department of Roentgenology, University of Michigan. Presented, as part of a Symposium on Brain Tumors, before the Radiological Society of North America, at the Twenty-seventh Annual Meeting, San Francisco, Calif., December 1–5, 1941.

TABLE I: 565 BRAIN TUMORS EXAMINED BY ROENTGEN METHODS: PROVED AND PREDICTED LOCATION

Number	Sex	Age	Proved Site of Tumor	Tumor Site as Predicted by Roentgen Ray Methods		
				Routine Skull	Encephalogram	Ventriculogram
ENCEPHALIC TUMORS						
Gliomas						
Glioma unclassified						
286356	M	50	Cerebral	Uncertain	.....	.....
372697	M	51	Frontal	Uncertain	Correct	.....
374338	F	37	"	Uncertain	.....	.....
260316	F	35	"	Uncertain	.....	.....
441667	M	33	"	No sign	.....	Correct
459467	M	30	Fronto-temporal	No sign	.....	Correct
437831	M	35	" "	No sign	.....	Correct
420720	M	46	Fronto-parietal	No sign	.....	Correct
385479	F	42	" "	No sign	.....	Correct
409070	M	29	Corpus callosum	No sign	.....	Uncertain
468776	M	24	Parietal	No sign	.....	Correct
385749	M	54	Parieto-temporal	No sign	.....	.....
373523	F	36	" "	Uncertain	.....	Correct
383016	F	50	Temp-parieto-occip.	No sign	.....	Correct
479346	M	34	" " "	No sign	.....	Correct
377370	M	42	Parieto-occipital	No sign	Uncertain	.....
360317	F	43	" "	Correct	.....	Uncertain
348103	F	45	" "	Correct	.....	Correct
376396	M	9	Basal ganglia	Uncertain	.....	Correct
447094	F	18	" "	No sign	.....	WRONG
444526	M	9	" "	Uncertain	.....	.....
450984	M	1	Optic tract	Correct	.....	.....
321799	F	33	Cerebellar	No sign	.....	Correct
Glioblastoma multiforme						
417692	F	33	Cerebral	Uncertain	.....	.....
360900	F	51	"	No sign	.....	.....
402387	M	42	Frontal	No sign	.....	Correct
376115	F	42	"	No sign	.....	Correct
348007	F	9	"	Uncertain	.....	Correct
392796	M	42	"	Uncertain	.....	.....
376267	M	26	"	No sign	.....	Correct
377480	F	16	"	No sign	.....	Correct
418606	M	45	"	No sign	.....	Correct
453344	F	53	"	Uncertain	.....	Correct
453976	M	42	"	No sign	.....	Correct
340814	M	56	"	No sign	.....	.....
316765	M	20	"	Uncertain	.....	Correct
335363	F	54	"	Uncertain	.....	Correct
336814	F	18	"	Uncertain	.....	.....
462006	M	55	"	Uncertain	.....	Correct
345145	M	52	"	No sign	.....	Correct
438254	F	26	"	Uncertain	.....	.....
357736	M	31	"	No sign	.....	Correct
373611	M	37	"	No sign	.....	.....
281752	M	16	"	.....	.....	Correct
449510	F	53	"	Uncertain	.....	Correct
328454	M	21	"	No sign	.....	Correct
334975	M	49	"	.....	.....	Correct
477730	M	24	"	No sign	.....	Correct
386538	M	56	Fronto-temporal	Uncertain	.....	.....
435388	M	53	Fronto-parietal	Uncertain	.....	Correct
377364	F	47	" "	Uncertain	.....	.....
453580	M	37	" "	No sign	.....	Correct
453505	M	52	" "	Uncertain	.....	Correct
452682	F	46	" "	Uncertain	.....	Uncertain
428775	M	45	" "	No sign	.....	Correct
461097	F	14	" "	No sign	.....	Correct
330020	F	30	" "	No sign	.....	.....
297691	M	52	" "	No sign	.....	Correct
336028	F	41	" "	No sign	Correct	.....
447977	M	55	Corpus callosum	No sign	.....	Correct
434595	M	47	Parietal	No sign	.....	Correct
207008	M	49	"	No sign	.....	.....

TABLE I—*Continued*

Number	Sex	Age	Proved Site of Tumor	Tumor Site as Predicted by Roentgen Ray Methods		
				Routine Skull	Encephalogram	Ventriculogram
456107	M	49	Parietal	No sign	.....	Correct
304609	F	60	"	No sign	.....	.....
333943	F	45	"	No sign	.....	Correct
336611	M	50	"	No sign	.....	Correct
419679	M	62	"	No sign	.....	Correct
195651	F	13	"	Correct	.....	.....
381531	M	49	"	No sign	.....	Correct
456267	F	59	"	No sign	.....	Correct
415275	M	55	"	.....	.....	Correct
388277	M	48	"	No sign	.....	Correct
296290	M	40	"	No sign	.....	Correct
335692	F	43	"	No sign	.....	.....
463364	M	49	Parieto-temporal	Correct	.....	.....
442008	M	55	" "	.....	.....	Correct
356605	M	23	" "	Uncertain	.....	.....
358090	M	54	" "	.....	.....	Correct
266860	M	29	" "	Uncertain	.....	.....
349185	F	45	" "	.....	.....	Correct
379343	M	45	" "	Uncertain	.....	.....
380206	M	54	" "	No sign	.....	.....
380754	M	52	" "	No sign	.....	.....
382429	M	19	" "	Uncertain	.....	.....
455811	M	19	" "	No sign	.....	Correct
409723	M	64	" "	Uncertain	.....	.....
309175	F	33	" "	No sign	.....	Correct
329091	F	42	" "	Uncertain	.....	.....
437975	M	62	" "	No sign	.....	.....
474055	F	51	" "	No sign	.....	.....
386421	M	56	" "	Uncertain	.....	.....
381802	F	60	Temporal	No sign	.....	Correct
396912	F	50	"	Uncertain	.....	.....
374104	M	63	"	No sign	.....	Correct
413403	F	46	"	.....	.....	Correct
326113	F	43	"	No sign	.....	Correct
435678	M	48	"	No sign	Correct	.....
369787	M	46	"	No sign	.....	.....
449746	F	20	"	Uncertain	.....	Correct
436024	M	48	"	Uncertain	.....	.....
401031	F	50	"	Uncertain	.....	Correct
475066	M	39	"	No sign	.....	.....
321377	M	32	"	No sign	.....	.....
327480	F	37	"	No sign	.....	Correct
418809	M	48	Temp-parieto-occip.	No sign	.....	.....
347117	M	59	" " "	No sign	Uncertain	Correct
377134	F	44	" " "	No sign	.....	.....
378007	M	36	Parieto-occipital	No sign	.....	Correct
421815	M	52	" "	Uncertain	.....	Correct
459025	M	49	" "	Uncertain	.....	.....
467114	M	51	" "	No sign	.....	Correct
288568	F	51	" "	WRONG	.....	.....
298116	M	48	" "	No sign	.....	.....
324027	F	38	" "	Uncertain	.....	Correct
303340	M	36	Occipital	.....	.....	Correct
448572	M	52	"	No sign	.....	Correct
313375	M	27	Pineal region	No sign	.....	Correct
322541	F	31	" "	Uncertain	.....	Correct
373083	M	57	Basal ganglia	Uncertain	.....	.....
442113	M	26	" "	Uncertain	.....	.....
354901	M	14	" "	No sign	.....	Correct
413435	F	15	" "	.....	.....	Correct
372371	M	29	" "	No sign	.....	Correct
394362	M	31	Suprasellar	.....	.....	Correct
330543	F	10	Cerebellar	Correct	.....	Correct
Spongioblastoma polare						
364943	F	68	Frontal	No sign	Correct	.....
342757	F	36	Fronto-temporal	.....	.....	Correct
337010	M	44	Fronto-parietal	.....	.....	Correct

TABLE I—*Continued*

Number	Sex	Age	Proved Site of Tumor	Tumor Site as Predicted by Roentgen Ray Methods		
				Routine Skull	Encephalogram	Ventriculogram
Spongioblastoma polare (*cont.*)						
338178	F	20	Parietal	Uncertain	.....	Correct
358553	M	44	"	Uncertain	.....	Correct
398650	F	34	Pineal region	No sign	.....	Correct
473015	F	7	Basal ganglia	.....	.....	Uncertain
406497	M	2	Optic tract	Correct	.....	.....
308448	M	6	" "	Correct	.....	.....
312245	M	15	" "	Uncertain	.....	.....
386323	F	4	Chiasm	Uncertain	.....	Uncertain
436825	M	32	Suprasellar	Correct	.....	.....
321448	F	60	Cerebellopontine angle	No sign	.....	.....
340909	M	47	" "	Uncertain	.....	.....
345239	M	42	Pontine	No sign	.....	.....
473433	M	28	"	No sign	.....	.....
357264	F	17	"	Uncertain	.....	.....
471390	M	31	Posterior fossa	Correct	.....	.....
396415	M	5	" "	Uncertain	.....	Correct
156615	F	42	Cerebellar	No sign	.....	.....
375713	M	14	"	No sign	.....	Correct
Ependymoma						
269097	M	6	Frontal	Correct	.....	.....
274429	F	11	"	No sign	.....	Correct
436786	F	62	"	No sign	.....	Correct
323867	F	13	"	.....	.....	Correct
449797	F	49	Fronto-temporal	No sign	.....	Correct
191462	M	35	Fronto-parietal	Correct	.....	.....
337300	M	25	Parietal	Uncertain	.....	Correct
468305	M	17	"	No sign	.....	Correct
280577	M	22	Temporal	.....	.....	Correct
333156	M	31	"	Correct	.....	.....
352233	M	53	"	Uncertain	.....	Uncertain
473620	F	9	"	No sign	.....	Correct
344645	F	6	Parieto-occipital	Uncertain	.....	Correct
338567	F	19	Lateral ventricle	Uncertain	.....	Correct
284846	M	34	Third ventricle	Uncertain	.....	Uncertain
270355	F	44	Pineal region	No sign	.....	Correct
288180	M	26	" "	Uncertain	.....	WRONG
379229	M	47	Cerebellar	Uncertain	.....	Correct
365301	F	3	Fourth ventricle	Correct	.....	.....
417719	F	4	" "	Correct	.....	.....
328283	F	3	" "	Uncertain	.....	.....
336435	F	41	" "	Uncertain	.....	.....
Astroblastoma						
482231	M	56	Frontal	Uncertain	.....	Correct
365557	M	38	Fronto-parietal	Uncertain	.....	Correct
374098	F	40	" "	No sign	Correct	.....
429252	M	51	Temporal	No sign	.....	.....
385090	M	57	"	Uncertain	.....	Correct
342394	M	41	"	No sign	.....	.....
434208	M	63	Temp-parieto-occip.	No sign	.....	Correct
Astrocytoma						
350317	F	45	Widespread	No sign	.....	Uncertain
311204	F	38	"	WRONG	.....	Correct
313760	F	50	"	Uncertain	.....	.....
365533	M	35	Frontal	Uncertain	.....	Uncertain
434668	F	29	"	Uncertain	.....	Correct
374244	F	32	"	Uncertain	.....	.....
279633	M	46	"	No sign	Uncertain	Correct
259005	F	34	"	Uncertain	.....	Correct
281178	F	14	"	Uncertain	.....	.....
281504	M	55	"	No sign	.....	Correct
308849	M	31	"	No sign	Correct	.....
325343	F	55	"	.....	.....	Correct
424625	M	37	"	No sign	Uncertain	.....
347543	M	32	"	Uncertain	.....	Correct
390403	F	36	"	No sign	.....	Correct

TABLE I—*Continued*

Number	Sex	Age	Proved Site of Tumor	Tumor Site as Predicted by Roentgen Ray Methods		
				Routine Skull	Enceph-alogram	Ventric-ulogram
482047	M	36	Frontal	Uncertain	.....	.....
447239	M	21	"	Uncertain	.....	Correct
443575	F	38	"	No sign	Uncertain	Correct
388226	F	34	"	No sign	.....	Correct
286627	M	40	"	Correct	Correct	.....
299123	F	38	"	No sign	.....	.....
300703	F	39	"	No sign	.....	.....
311818	M	34	"	Uncertain	.....	Correct
450840	M	37	Fronto-temporal	No sign	Correct	.....
388150	M	51	" "	No sign	.....	Uncertain
346601	M	32	" "	No sign	Correct	.....
362233	F	24	" "	Uncertain	.....	Correct
374657	M	49	" "	Uncertain	.....	.....
401859	F	25	Fronto-parietal	No sign	Correct	.....
275860	M	14	" "	Correct	.....	.....
444294	M	29	" "	No sign	.....	Correct
304142	M	24	" "	No sign	.....	.....
327192	M	42	" "	No sign	.....	Correct
329000	M	29	" "	No sign	.....	.....
469000	F	45	" "	No sign	.....	Correct
299929	M	40	" "	No sign	Correct	.....
344632	M	50	" "	No sign	Uncertain	Correct
394301	M	34	Fronto-temporo-parietal	No sign	.....	Correct
352556	F	6	Parietal	No sign	.....	Uncertain
283422	M	42	"	Uncertain	.....	.....
429257	M	52	"	No sign	.....	Correct
297041	M	39	"	No sign	Correct	.....
311526	M	47	"	Correct	.....	.....
327831	M	52	"	No sign	.....	.....
362458	M	34	Parieto-temporal	No sign	Correct	.....
276228	M	33	" "	Correct	.....	.....
277256	F	29	" "	Uncertain	.....	.....
272543	F	14	" "	.....	Uncertain	.....
405421	M	40	Temporal	No sign	.....	.....
318365	M	33	"	Uncertain	.....	Correct
286474	M	44	"	No sign	.....	Correct
296076	M	39	"	No sign	Correct	Correct
335172	M	30	"	Uncertain	Uncertain	Correct
376893	M	39	"	Uncertain	.....	Correct
454065	F	14	"	.....	.....	Correct
434747	M	30	"	Uncertain	.....	Correct
284008	M	43	"	Uncertain	.....	.....
302267	M	63	"	No sign	.....	Correct
305307	F	26	"	No sign	Correct	.....
327206	M	32	"	No sign	Correct	Correct
447252	M	35	Temp-parieto-occip.	Uncertain	.....	.....
298166	M	32	" " "	No sign	.....	.....
324893	M	25	" " "	Uncertain	Correct	Correct
330088	M	23	" " "	No sign	.....	Correct
270570	M	53	Lateral ventricle	No sign	Uncertain	.....
350900	F	14	Pineal region	Uncertain	.....	Correct
398521	M	11	Basal ganglia	Uncertain	.....	Correct
347278	M	27	" "	Uncertain	.....	Correct
363531	F	11	" "	Correct	.....	Correct
418971	M	37	" "	No sign	.....	Uncertain
263873	M	9	" "	Uncertain	Uncertain	Correct
378619	F	38	" "	Uncertain	.....	Correct
375501	M	6	" "	No sign	.....	.....
380100	F	26	Suprasellar	No sign	.....	Correct
270821	M	16	Cerebellopontine angle	No sign	.....	.....
347818	F	5	Pontine	No sign	.....	.....
301788	F	7	"	No sign	.....	.....
275131	M	9	Posterior fossa	Uncertain	.....	.....
348776	F	8	Cerebellar	Uncertain	.....	.....
355695	F	11	"	Correct	.....	.....
407134	F	14	"	.....	.....	Correct
270003	F	11	"	Uncertain	.....	.....
450141	M	13	"	Uncertain	.....	.....
380363	F	12	"	No sign	.....	Correct

TABLE I—*Continued*

Number	Sex	Age	Proved Site of Tumor	Tumor Site as Predicted by Roentgen Ray Methods		
				Routine Skull	Encephalogram	Ventriculogram
Astrocytoma (*cont.*)						
447268	M	19	Cerebellar	Uncertain	.....	Correct
458375	F	7	"	.....	.....	Correct
465117	M	15	"	Uncertain	.....	Correct
338451	F	15	"	Uncertain	.....	Correct
316437	F	25	"	Uncertain	.....	Correct
352200	F	11	"	Uncertain	.....	Correct
372657	M	15	"	Uncertain	.....	.....
276128	M	10	"	Correct	.....	.....
398554	F	13	"	Uncertain	.....	Correct
440341	F	8	"	Uncertain	.....	.....
456914	M	9	"	Uncertain	.....	.....
465763	M	22	"	Uncertain	.....	.....
423343	M	9	"	Uncertain	.....	Correct
391661	M	3	"	.....	.....	Correct
285418	F	38	"	No sign	.....	Correct
300660	F	9	"	Correct	.....	.....
312823	M	16	"	No sign	.....	.....
325991	F	23	"	.....	.....	Correct
399284	M	15	"	Uncertain	.....	.....
402272	F	8	"	Uncertain	.....	Correct
363534	F	10	"	Uncertain	.....	Correct
427537	F	12	"	Uncertain	.....	.....
382011	F	7	"	Uncertain	.....	Correct
447840	F	10	"	Uncertain	.....	Correct
268963	F	17	"	Uncertain	.....	Correct
380676	F	24	"	Uncertain	.....	Correct
379055	M	31	"	WRONG	.....	Correct
380155	M	12	"	Uncertain	.....	Correct
395859	M	4	"	Uncertain	.....	Correct
393514	F	14	"	Uncertain	.....	.....
308735	F	16	"	Uncertain	.....	Correct
336482	M	6	"	.....	.....	Correct
389126	M	11	Fourth ventricle	Uncertain	.....	Correct
392043	M	8	" "	Uncertain	.....	Correct
453197	M	6	" "	Uncertain	.....	Correct
Oligodendroglioma						
463471	M	42	Frontal	Correct	.....	.....
407770	F	54	"	Correct	.....	.....
369791	M	36	"	Correct	.....	.....
343622	F	28	"	Correct	.....	.....
397570	M	44	"	Uncertain	Correct	.....
457447	M	54	"	No sign	Uncertain	.....
340278	M	50	"	Correct	.....	.....
344778	M	28	"	Correct	.....	.....
273561	F	45	"	No sign	.....	.....
409970	M	45	"	Correct	.....	.....
412141	F	43	"	Correct	.....	.....
395073	M	31	"	No sign	.....	Correct
281757	M	38	"	Correct	.....	.....
387600	M	37	"	.....	.....	Correct
425978	F	44	Fronto-temporal	Correct	.....	.....
240736	M	41	Fronto-parietal	No sign	Uncertain	.....
400671	M	49	" "	Correct	Correct	.....
461806	F	49	" "	Uncertain	.....	Correct
354322	M	58	Fronto-temporo-parietal	Uncertain	.....	.....
421724	M	42	" " "	Correct	.....	Correct
392452	F	41	" " "	Uncertain	.....	Correct
441938	M	34	Corpus callosum	No sign	.....	Correct
367411	M	36	" "	Uncertain	.....	Correct
429255	F	66	Parietal	Correct	.....	.....
309294	F	18	"	Correct	.....	.....
386290	F	21	Temporal	Correct	.....	.....
439862	M	45	Temp-parieto-occip.	Correct	.....	Correct
454511	F	27	Lateral ventricle	Uncertain	.....	Correct
433283	M	25	Pontine	No sign	.....	Correct
434430	M	15	"	Uncertain	.....	Correct

TABLE I—*Continued*

Number	Sex	Age	Proved Site of Tumor	Tumor Site as Predicted by Roentgen Ray Methods		
				Routine Skull	Encephalogram	Ventriculogram
Glioneuromas						
Medulloblastoma						
415763	F	3	Widespread	.....	.....	Uncertain
276393	M	47	Frontal	.....	.....	Correct
415462	M	36	"	Uncertain	.....	Correct
347992	F	12	Fronto-parietal	Uncertain	.....	Correct
422544	F	20	Temp-parieto-occip.	Uncertain	.....	Uncertain
309733	F	30	Pontine	No sign	.....	.....
398834	M	5	Posterior fossa	Uncertain	.....	.....
377160	M	19	Cerebellar	.....	.....	Correct
436714	F	22	"	Uncertain	.....	Correct
373566	M	32	"	No sign	.....	Correct
321255	F	4	"	Uncertain	.....	.....
324530	M	2	"	.....	.....	Correct
422236	M	33	"	Uncertain	.....	.....
448133	F	32	"	No sign	.....	.....
277253	F	8	"	Uncertain	.....	.....
335625	M	10	"	No sign	.....	.....
351554	M	15	"	Uncertain	.....	Correct
454346	M	32	"	No sign	.....	Correct
376295	M	10	"	Uncertain	.....	Correct
434728	M	8	"	Uncertain	.....	Correct
478516	M	2	"	Uncertain	.....	Correct
288670	M	20	"	No sign	.....	Correct
299305	M	3	"	Uncertain	.....	Correct
461755	M	3	Fourth ventricle	No sign	.....	Correct
351740	M	4	" "	Uncertain	.....	.....
352653	M	7	" "	Uncertain	.....	.....
354635	F	5	" "	Uncertain	.....	.....
434528	M	11	" "	Uncertain	.....	Correct
393007	F	4	" "	Uncertain	.....	Correct
393125	M	4	" "	No sign	.....	Correct
475527	M	11	" "	No sign	.....	Correct
458135	F	9	" "	Uncertain	.....	.....
442663	M	2	" "	Uncertain	.....	Correct
421663	F	9	" "	Uncertain	.....	.....
408798	M	3	" "	.....	.....	Correct
447530	F	2	" "	Uncertain	.....	.....
340288	F	2	" "	Uncertain	.....	.....
TUMORS OF COVERING CELLS OF NERVOUS SYSTEM						
Meningeal tumors						
Meningothelioma						
360261	F	44	Frontal	Uncertain	.....	.....
371652	F	53	"	Correct	.....	.....
371754	F	51	"	Uncertain	Correct	.....
451000	M	53	"	Correct	.....	.....
285764	F	50	"	Correct	.....	.....
335936	M	39	"	No sign	Correct	.....
368840	M	39	"	Uncertain	.....	Correct
381883	F	52	"	Uncertain	.....	Correct
389012	F	53	"	Uncertain	.....	Correct
443764	M	39	"	Correct	.....	Correct
410674	F	60	"	Uncertain	.....	Correct
425114	F	35	"	.....	.....	Correct
350414	M	60	"	Correct	.....	.....
442761	F	45	"	Uncertain	.....	Correct
271756	F	58	Fronto-temporal	Uncertain	.....	.....
465510	F	63	" "	Correct	.....	.....
399003	F	47	Fronto-parietal	Uncertain	.....	.....
296485	M	32	" "	No sign	Correct	.....
350041	F	56	" "	Uncertain	.....	Correct
349046	F	54	" "	Uncertain	.....	Correct
341987	M	48	" "	Uncertain	Correct	.....
367768	F	43	Parietal	Uncertain	.....	Correct
388981	M	20	"	Uncertain	.....	Correct
460854	F	23	"	Correct	.....	.....

TABLE I—*Continued*

Number	Sex	Age	Proved Site of Tumor	Tumor Site as Predicted by Roentgen Ray Methods		
				Routine Skull	Encephalogram	Ventriculogram
Meningothelioma (*cont.*)						
297110	M	59	Parietal	No sign	.....	.....
336829	F	38	"	Uncertain	.....	.....
285906	M	54	"	No sign	Correct	.....
309155	M	24	"	No sign	Correct	.....
132691	F	55	Parieto-temporal	Correct	.....	Correct
436562	M	48	Temporal	Uncertain	.....	Correct
365219	M	55	"	No sign	.....	Correct
365798	M	48	"	Uncertain	.....	.....
314639	F	32	Temporo-sphenoidal	Uncertain	.....	.....
380246	F	27	Parieto-occipital	Correct	.....	.....
349248	F	25	Lateral ventricle	Uncertain	.....	Correct
458610	M	20	" "	No sign	.....	.....
452159	F	30	" "	Uncertain	.....	Correct
460465	M	20	" "	Uncertain	.....	Correct
448308	F	41	Suprasellar	No sign	Correct	.....
295539	F	49	Cribriform plate	No sign	.....	Correct
328237	M	54	" "	Correct	.....	.....
350026	F	47	" "	Correct	.....	.....
350161	F	45	" "	Correct	.....	.....
130022	F	43	" "	Correct	.....	.....
293485	M	43	Sphenoid ridge	Correct	Correct	.....
450175	F	47	" "	Correct	Uncertain	.....
434348	M	26	" "	Uncertain	.....	Correct
336816	F	52	" "	Correct	.....	Correct
325576	F	22	" "	Uncertain	.....	Correct
376738	M	40	Mid fossa	Uncertain	.....	Correct
364159	M	42	" "	Uncertain	Correct	.....
457270	F	46	" "	Correct	.....	.....
440959	M	48	" "	.....	.....	Correct
327698	F	33	" "	Correct	.....	.....
415891	F	53	" "	Uncertain	.....	Correct
404722	F	54	" "	Correct	.....	.....
448990	F	34	" "	No sign	Correct	.....
416809	F	40	" "	Uncertain	.....	.....
278246	M	47	Cerebellopontine angle	Correct	.....	.....
348719	F	41	" "	Uncertain	.....	Correct
391352	F	50	" "	Correct	.....	.....
278409	F	57	" "	Correct	.....	.....
286554	M	53	" "	No sign	.....	.....
256512	F	52	Posterior fossa	WRONG	.....	Correct
432639	F	43	" "	Correct	.....	.....
303049	M	46	" "	WRONG	.....	Correct
373325	M	43	Cerebellar	Uncertain	.....	Correct
447817	M	47	"	No sign	.....	Correct
Fibroblastoma						
282762	M	18	Frontal	Uncertain	.....	.....
292393	F	20	Cerebellopontine angle	Correct	.....	.....
Osteoma						
366378	F	21	Mid fossa	Correct	.....	.....
Melanoblastoma						
375627	F	28	Fronto-parietal	No sign	.....	.....
464170	F	6	Cerebellar	Uncertain	.....	.....
Sarcoma						
456558	M	47	Frontal	No sign	.....	Correct
332402	M	66	"	Uncertain	.....	Correct
280942	F	2	"	Correct	.....	.....
287059	F	25	"	Correct	.....	.....
443392	F	36	Fronto-parietal	No sign	Uncertain	.....
427069	F	49	" "	.....	.....	Uncertain
334008	F	38	" "	Correct	Correct	Correct
281649	F	28	Parietal	Correct	.....	.....
358532	F	54	Temporal	No sign	.....	.....
306897	M	46	"	No sign	.....	Correct
417663	M	57	Parieto-occipital	Uncertain	.....	.....

TABLE I—*Continued*

Number	Sex	Age	Proved Site of Tumor	Tumor Site as Predicted by Roentgen Ray Methods		
				Routine Skull	Encephalogram	Ventriculogram
413040	M	30	Parieto-occipital	Uncertain	.....	Correct
314666	M	48	" "	Uncertain	Uncertain	.....
465946	M	44	" "	No sign	Correct	Correct
268772	M	13	Mid fossa	Uncertain	.....	.....
289113	F	3	Cerebellopontine angle	Uncertain	.....	.....
Sheath Tumors						
Neurinoma						
306921	F	3	Chiasm	Uncertain	.....	Correct
325959	F	21	Mid fossa	Correct	.....	.....
359143	M	49	Acoustic	No sign	.....	.....
457252	M	39	"	Correct	.....	.....
460508	F	52	"	Uncertain	.....	Correct
448343	F	23	"	Correct	.....	.....
395364	M	30	"	No sign	.....	.....
370434	F	46	"	Correct	.....	.....
227616	F	38	"	No sign	.....	.....
280175	F	27	"	Correct	.....	.....
392853	M	52	"	Correct	.....	.....
285231	M	62	"	No sign	.....	.....
306115	F	46	"	Uncertain	.....	Uncertain
306236	M	36	"	No sign	.....	.....
322227	F	52	"	Correct	.....	.....
331240	F	63	"	Correct	.....	.....
453633	F	54	"	Correct	.....	.....
439657	F	25	"	.....	.....	Correct
438684	F	40	"	No sign	.....	.....
400670	M	47	"	Correct	.....	.....
357292	F	42	"	No sign	.....	.....
349177	F	42	"	.....	.....	Uncertain
472589	M	23	"	Correct	.....	.....
286092	F	20	"	No sign	.....	.....
292543	M	50	"	Correct	.....	.....
337461	M	23	"	Correct	.....	.....
375168	M	27	"	Correct	.....	Correct
283863	F	16	"	Uncertain	.....	.....
379438	F	39	Cerebellopontine angle	No sign	.....	Correct
473998	F	24	" "	No sign	.....	.....
322801	M	43	" "	No sign	.....	.....
327518	F	43	" "	No sign	.....	Uncertain
393557	F	57	" "	Uncertain	.....	Correct
360790	F	23	" "	No sign	.....	.....
426415	F	44	" "	Uncertain	.....	.....
HYPOPHYSEAL TUMORS						
Adenomas						
Undifferentiated						
348680	M	51	Intrasellar	Uncertain	.....	.....
277311	F	20	"	Correct	.....	.....
445724	F	42	"	Correct	.....	.....
315824	F	62	"	Correct	.....	.....
Basophile						
324616	M	19	Intrasellar	No sign	.....	.....
Chromophobe						
283887	M	26	Parasellar	Uncertain	.....	.....
348327	F	59	Intrasellar	Correct	.....	.....
356618	M	27	"	Correct	.....	.....
357903	F	49	"	Correct	.....	.....
423391	M	30	"	Correct	.....	.....
432301	M	35	"	Correct	.....	.....
474498	F	52	"	Correct	.....	Correct
248006	M	23	"	Correct	.....	.....
274152	M	52	"	Correct	.....	.....
275734	M	46	"	Correct	.....	.....
391793	M	50	"	Correct	.....	.....
449470	F	28	"	Correct	.....	.....

TABLE I—*Continued*

Number	Sex	Age	Proved Site of Tumor	Tumor Site as Predicted by Roentgen Ray Methods		
				Routine Skull	Encephalogram	Ventriculogram
Chromophobe (*cont.*)						
439015	F	44	Intrasellar	Correct	.....	.....
461983	M	28	"	Correct	.....	.....
418703	M	23	"	Correct	.....	.....
298023	F	41	"	Correct	.....	.....
282821	F	51	"	Uncertain	.....	.....
290725	F	32	"	Uncertain	.....	.....
291200	F	37	"	Correct	.....	.....
294439	F	19	"	Correct	.....	.....
321520	M	23	"	Correct	.....	.....
332770	F	46	"	Correct	.....	.....
382325	F	37	Intra and suprasellar	Correct	.....	.....
399982	M	35	" " "	Correct	Correct	.....
Craniopharyngioma						
279134	M	54	Intrasellar	Correct	Correct	Uncertain
279937	M	8	"	Correct	.....	.....
283463	M	11	"	Correct	.....	.....
383197	M	23	Intra and suprasellar	Correct	.....	.....
349438	F	5	" " "	Correct	.....	.....
349782	M	7	" " "	Correct	.....	.....
354430	F	11	" " "	Correct	.....	.....
363828	F	10	" " "	Correct	.....	.....
365866	M	41	" " "	Correct	.....	.....
415881	M	31	" " "	No sign	.....	.....
371568	M	8	" " "	.....	.....	Correct
429261	F	30	" " "	Correct	.....	.....
233210	M	41	" " "	Correct	.....	.....
273706	F	22	" " "	Correct	.....	.....
425456	F	5	" " "	Correct	.....	.....
418372	M	44	" " "	.....	.....	Uncertain
447129	F	31	" " "	No sign	.....	Correct
383029	M	31	" " "	Uncertain	.....	Correct
387618	F	51	" " "	Correct	.....	.....
299521	F	4	" " "	Correct	.....	.....
312891	M	24	" " "	Correct	.....	.....
332805	M	8	" " "	Correct	.....	.....
DYSEMBRYOMAS						
Teratoid cyst						
355157	M	9	Third ventricle	Uncertain	.....	Correct
298724	M	22	Pineal region	Uncertain	.....	Correct
419004	F	24	Fourth ventricle	No sign	.....	.....
Pearly tumor						
433830	M	44	Cerebellopontine angle	No sign	.....	.....
436030	F	6	Cerebellar	Uncertain	.....	Correct
369875	F	8	"	Uncertain	.....	Correct
323543	F	43	Fourth ventricle	Uncertain	.....	Correct
Chordoma						
313611	F	42	Pontine	No sign	.....	.....
Pinealoma						
430452	F	18	Pineal region	Uncertain	.....	Correct
409999	M	13	" "	Correct	.....	Correct
346766	M	15	" "	Correct	.....	Correct
474964	M	13	" "	.....	.....	Correct
287553	M	21	" "	No sign	.....	Correct
328665	M	14	" "	.....	.....	Correct
370781	M	37	" "	Correct	.....	Correct
453334	M	24	" "	Uncertain	.....	Correct
458133	M	15	" "	Uncertain	.....	Correct
471691	F	52	" "	Uncertain	.....	Correct
Papilloma						
428807	F	7	Lateral ventricle	Uncertain	.....	Correct
371995	M	45	Fourth ventricle	Uncertain	.....	Correct
462918	M	42	" "	No sign	.....	Correct

TABLE I—*Continued*

Number	Sex	Age	Proved Site of Tumor	Tumor Site as Predicted by Roentgen Ray Methods		
				Routine Skull	Encephalogram	Ventriculogram
VASCULAR TUMORS						
Hemangioblastoma (Lindau's type)						
320215	F	55	Cerebellopontine angle	No sign	.....	.....
292829	F	25	Posterior fossa	Uncertain	.....	Correct
321054	M	53	" "	Uncertain	.....	Correct
373418	M	20	Cerebellar	No sign	.....	Correct
474124	M	32	"	No sign	.....	.....
197383	M	15	"	Uncertain	.....	Correct
272548	F	20	"	No sign	.....	.....
308181	F	49	"	Uncertain	.....	Correct

With exception of a slight increase in the proportion of hypophyseal tumors at the expense of the gliomas, the distribution according to histological characteristics has not been materially altered by the addition of 375 new tumors to the original series. Examples of astroblastoma, osteoma, melanoblastoma, and papilloma have been added to classifications which previously were not represented. Throughout the entire period there have been no examples of eosinophilic adenoma of the pituitary which conform to the criteria used in this study. Radiation being the treatment of choice in these tumors, none has been subjected to craniotomy and in no case has autopsy been performed. The rarity of neuro-epithelioma, ganglioneuroma, lipoma, and angioma racemosum among brain tumors and the infrequency with which capillary telangiectasis produces alarming symptoms or signs are attested by the fact that none of these are represented in a tumor group of this size. Tumors of glial origin have continued to predominate, representing nearly 60 per cent of the ten-year series, while only three tumors arising from vascular tissues have been added in seven years.

METHODS OF DIAGNOSIS

In many patients the existence of intracranial neoplasm can be recognized without difficulty on the basis of observations other than those which depend upon the use of roentgen rays. Characteristic symptoms and specific neurological signs may even lead the neurosurgeon unerringly to the exact site of the offending tumor. Roentgenologic investigation, on the other hand, is often of great value in confirming the existence of an intracranial lesion, frequently establishes its anatomical location and, on occasion, offers the surest means of determining the best avenue of surgical approach. To derive the fullest benefits from the assistance which may be offered by x-ray examination, it is imperative that co-operation of the closest sort be practised by workers in all of the specialized fields involved in the diagnosis, treatment, and clinical investigation of intracranial diseases. There is no room for serious individual or departmental rivalry if the best clinical results are to be achieved in this difficult and highly technical field.

By no means underestimating the necessity for teamwork, which is so important in brain tumor diagnosis, it is worth while for roentgenologists to investigate, from time to time, the intrinsic value of their particular contribution to the group effort. Since the practical handling of patients involves the employment of all useful diagnostic procedures in rapid sequence, neurological opinions often include convictions based largely or in part upon roentgen findings. It is more readily possible to evaluate roentgenologic opinions, for by established practice these are based solely upon objective film evidence. Of all the comments which may appear in a report of x-ray findings in the case of a brain tumor patient, those which predict the location of the lesion are of the greatest practical im-

TABLE II: 565 BRAIN TUMORS CLASSIFIED ACCORDING TO BAILEY

	Number	Total	Per Cent
ENCEPHALIC TUMORS		361	63.9
Gliomas			
Glioma unclassified	23		
Glioblastoma multiforme	102		
Spongioblastoma polare	21		
Ependymoma	22		
Neuroepithelioma	0		
Astroblastoma	7		
Astrocytoma	119		
Oligodendroglioma	30		
Glioneuromas			
Medulloblastoma	37		
Ganglioneuroma	0		
TUMORS OF COVERING CELLS (NERVOUS SYSTEM)		124	22.0
Meningeal tumors			
Meningothelioma	68		
Fibroblastoma	2		
Osteoma	1		
Lipoma	0		
Melanoblastoma	2		
Sarcoma	16		
Sheath tumors			
Neurinoma	35		
HYPOPHYSEAL TUMORS		51	9.0
Adenomas			
Undifferentiated	4		
Basophile	1		
Eosinophile	0		
Chromophobe	24		
Craniopharyngiomas	22		
DYSEMBRYOMAS		21	3.7
Teratoid cyst	3		
Pearly tumor	4		
Chordoma	1		
Pinealoma	10		
Papilloma	3		
VASCULAR TUMORS		8	1.4
Hemangioblastoma (Lindau's type)	8		
Angioma racemosum	0		
Capillary telangiectasis	0		
	565	565	100%

portance and are most readily usable for purposes of evaluation.

Three roentgenologic procedures have been in use at the University Hospital during the past ten years in searching for brain tumors: an established routine survey of the entire skull, and the more complicated aerographic methods, encephalography and ventriculography. Although some form of roentgenologic examination was employed in each of the brain tumor cases which comprise this group, that being one of the criteria for inclusion, it is not true that all three were carried out in every instance. Routine skull examination was seldom omitted, although when patients presented films of good quality on admission, aerography was sometimes ordered without further ado. Encephalography was seldom employed; ventriculography much more frequently, in half of the cases in fact.

In the interests of sound practice, aerographic examination was omitted whenever its assistance was not considered necessary to accurate preoperative localization or when, because of the patient's physical condition, it seemed unwise to preface craniotomy with a highly technical procedure.

EVALUATION OF ROENTGENOLOGIC EXAMINATION

Taking into consideration its total usage, each of the three x-ray procedures was scored for proved localizing accuracy. Compared with previously reported values, there has been surprisingly little change.

TABLE III: ACCURACY OF ROENTGENOLOGIC EXAMINATION

X-Ray Method	Three Years 190 Cases		Ten Years 565 Cases	
	Times Used	Accuracy, %	Times Used	Accuracy, %
Routine skull examination	167	30	527	24
Encephalography	21	76	48	68.8
Ventriculography	70	91.4	282	92.2

Since the application of roentgen methods was not uniform throughout the entire series, individual accuracy ratings are apt to be misleading. Although some form of x-ray study was used in every one of the 565 cases, sometimes all three (Table I), the procedure of ventriculography, highly accurate as a means of obtaining localizing information, was not always called into play even though routine skull examination had not pointed out the tumor site. Contrasting figures for individual accuracy with the selective utility of each method, it is found that routine skull examination, considered

without reference to aerographic methods and despite the fact that it was not tried in 7 per cent, was successful in 126 instances, or 22.3 per cent. Encephalography, exerting its high individual accuracy upon no more than 41 cases because of the partial over-lapping of routine skull examinations already considered, scored 27 times in localizing 4.8 per cent of the entire series. Had ventriculography been tried in the case of all tumors not thus far localized, its proved ability as a localizing device might have finished the entire job with no more than a negligible error. In the judgment of the neurosurgeon, however, this method was needed in but 262 of the remaining 412 cases. Of this group, it localized 242, 43 per cent of the whole series.

Except for 28 cases, 3.5 per cent of the total group, aerographic methods yielded accurate information regarding tumor site when called upon to provide help in situations where routine skull examination was not effective. Eighteen times ventriculographic evidence of tumor site was vague; only twice did this procedure give misleading information. The unslackening demand for roentgenologic aid in determining the location of brain tumors further attests the practical utility of x-ray methods.

The relative efficacy of roentgen examination of the cranial vault as compared with the more elaborate aerographic procedures depends to a very material extent upon the location of tumors with respect to neighboring bone, the propensity of the tumor to invade or otherwise modify the structure of bone, and its tendency to acquire deposits of lime salts. Confined to 51 tumors of the hypophysis, the routine skull procedure was highly efficient, as one might expect, providing localizing signs with an accuracy of 80 per cent. Bony changes alone were enough to determine the location of 34.6 per cent of 124 meningeal and cranial nerve sheath tumors. The position of other supratentorial tumors, indicated occasionally by included calcium deposits, was far less frequently determined without the aid of air-injection methods, 12.5 per cent, while in the case of infratentorial tumors the localizing value of simple skull examination fell off to 6.3 per cent.

In actual experience the efficiency of ventriculography, used when other methods have failed, bears an inverse relationship, having scored successfully in 6 per cent, 28.2 per cent, 51.2 per cent, and 55 per cent in the same patient groups.

The effective use of encephalography was limited to the meningeal and supratentorial groups, where it scored 8.1 per cent and 6.1 per cent, respectively. As observed in the case of the entire tumor group, omission of aerographic examination in many instances has undoubtedly to some extent robbed aerographic methods of further laurels which might have been won. One must remember that in each group methods more elaborate than skull examination were not called into play except where necessary.

In so far as the roentgenologist is concerned in the management of brain tumor patients, provision of adequate equipment, facility in its use, and keen diagnostic ability based upon rich experience are prime requisites. Without these his contributions to brain tumor diagnosis will be of insignificant importance and may even be of negative value. If, over and above these minimal qualifications, he is able when consulted to offer sound advice regarding the type and extent of x-ray examination best suited to the particular problem in hand, the importance of the roentgenologist in any group dealing with brain tumors is greatly enlarged.

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Application of Some New Technics to Study of Brain Tumors[1]

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ALTHOUGH THE two special technics for the study of brain tumors which we wish to discuss originated long before the advent of the x-ray methods, they have had only limited application in clinical investigations. The modern electroencephalographic (EEG) procedure, which is based upon the work of Caton (1), in 1874, required the genius of Berger (2) to display its potentialities, in 1929, while the petrographic microscope, although thoroughly understood by Biot (3), in 1812, needed the studies of Herzog (4), in 1921, and more recently Schmitt and Bear (5), in 1935, to open the new vistas of ultra-structure behind the normal nerve tissue.

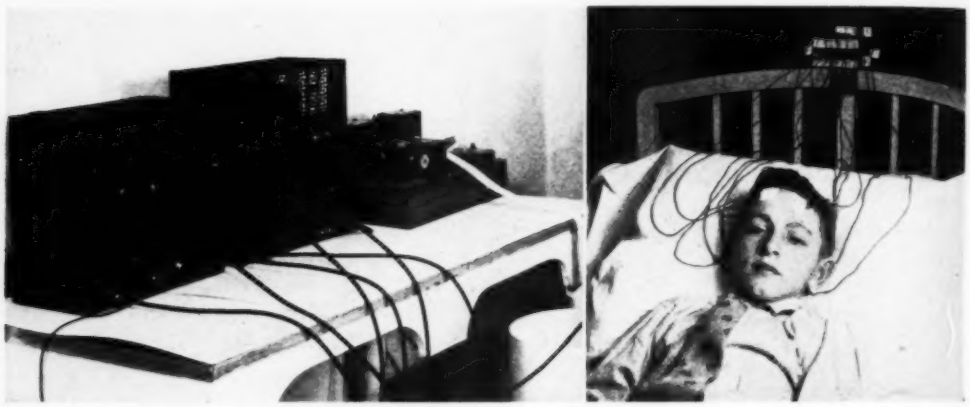


Fig. 1. Two-channel Grass electroencephalograph. From left to right are, first, the pair of metal boxes containing the low level amplifiers; second, the pair containing the power amplifiers and, finally, the ink writing oscillograph.

Fig. 2. Subject reclining on bed during a test, with the electrodes applied and connected to the input panel on the head of the bed. The frontal electrodes and the indifferent electrodes on the ears can be identified by the adhesive strips used to hold them on the skin.

ELECTROENCEPHALOGRAPHY

The technic of electroencephalography is similar to that of electrocardiography, except that greater sensitivity has been obtained by means of audioamplifiers and more rugged recording units have been devised to withstand the sudden large voltage fluctuations that occur (Fig. 1). Small metal electrode plates are held to the intact scalp by adhesive or collodion (Fig. 2). Electrode paste under the plate keeps the contact under 10,000 ohms' resistance. Electrodes on the ear lobes are used as the standard reference points. A tracing of the voltage fluctuations between any lead on the scalp and the ear lobes is a monopolar electroencephalogram.

The normal brain waves, or EEG patterns, made under the standard conditions of repose with the eyes closed, are best illustrated in the work of Pauline Davis (6), 1941. The dominant rhythm of 8–13 cycles, or waves/second, and 10–100 μV (micro or millionths of a volt) is called the alpha rhythm. The percentage of time that this rhythm occupies in the tracing varies in individuals. Some normal persons

[1] From the Department of Radiology, Harper Hospital, Detroit, Mich. Presented, as part of a Symposium on Brain Tumors, before the Radiological Society of North America, at the Twenty-seventh Annual Meeting, San Francisco, Calif., Dec. 1–5, 1941.

Fig. 3. Case I: Encephalogram showing displaced septum and deformed right ventricular pattern.

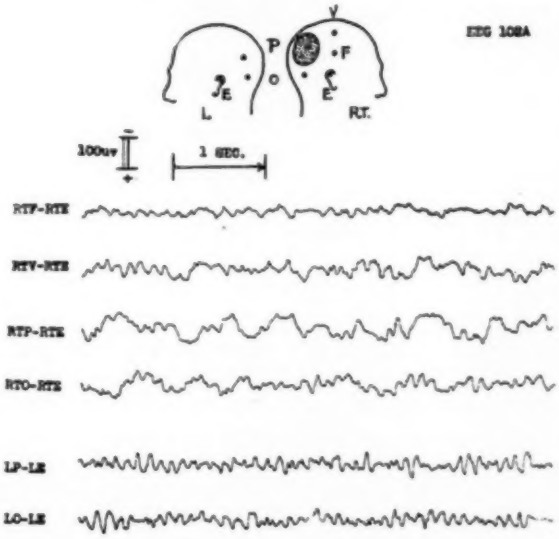


Fig. 4. Case I: EEG. Calibrations of sensitivity in μV and time in seconds is given in the upper left corner. A diagram of the lateral view of the head shows by letters the placement of the electrodes. All records are monopolar; that is, each scalp lead is compared to one or both ear lobes. The cross-hatched area on the diagram gives the EEG localization of cortical disturbance. The delta focus in this case is in the RTP-RTE record (single-channel amplifier used) and consists of slow waves of 1–3 cycles/second at 50 to about 100 μV dominantly present in this local area.

show none of this alpha rhythm during repose. Other frequencies are also present in varying degrees. A 16–24 cycle/second rhythm at less than 20 μV is usually present. Often there is a frequency of 1–4 cycles/second at less than 40 μV, which produces a rocky base line to the record. Sometimes frequencies of 4–8 cycles/second are present, but these are not usually organized into definite trains in the normal individual.

The variations in normal records are the expressions of individuality of the brain's activity, related by Davis (6) to the stability of behavior.

The electrical disturbances demonstrable in these records, produced by cerebral lesions, were first described by Walter (7), in 1936. Later, Williams and Gibbs, in 1938 (8) and 1939 (9), summarized the results in over 100 cases. Foerster, in 1935 (10), recorded directly from tumors exposed at operation but found that they were electrically inactive. The tissue around the tumor, however, displayed a variety of waves, which usually fell below 4 cycles per second and attained a voltage of 100 μV. Walter was the first to show that this activity indicated the site of a lesion within the cerebrum when tracings were made from the intact scalp. He called them delta waves. They interfere with the normal tracing in a selected site when the effects of a tumor are confined to a localized area. Such an area is called a delta focus. By the presence of such a focus, some brain lesions can be quite accurately localized.

Case I is that of a 46-year-old white male who, one week following a head injury, had the cardinal symptoms of headache and projectile vomiting. An encephalogram made four months later (Fig. 3), when he first consulted a physician, revealed evidence of a tumor or subdural hematoma of the right hemisphere in the parietal region, displacing the interventricular septum and the right lateral and third ventricles toward the left, with some flattening of the superior aspect of the right lateral ventricle.

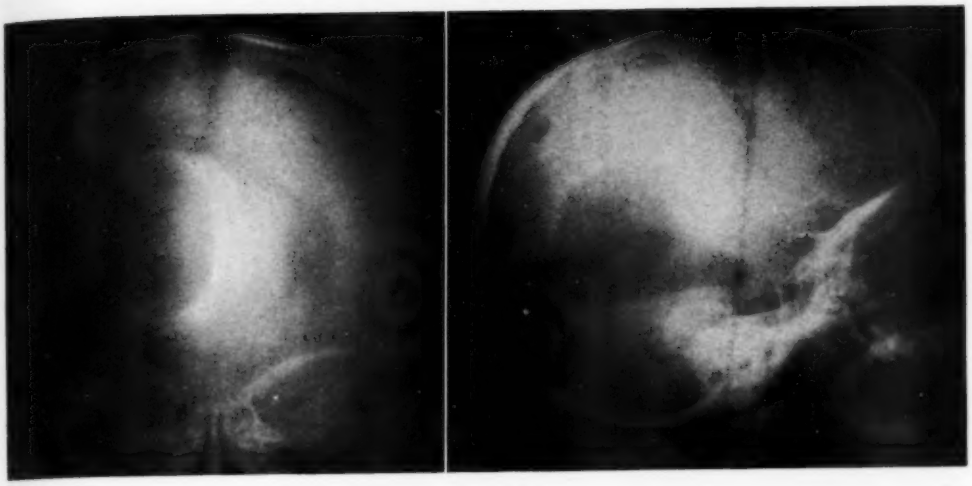
The EEG tracings (Fig. 4) show a clear delta focus in the right occipito-parietal area. The time and voltage scales are represented in the upper left-hand corner of the illustration. The schematic diagram of the head shows the location of the lesion, as outlined by the EEG, and the letters at the left of each record indicate the areas from which each tracing was made. In this case, the third record from the top has the strongest delta waves (delta focus) and is consequently from the brain region with the greatest disturbance resulting from the cerebral lesion present.

At autopsy, a right occipito-temporal glioblastoma was found which extended from the surface of the cortex to the third ventricle.

Case II is that of a 53-year-old woman who, for over a period of ten years, had attacks of coma lasting for one-half hour each. A right-sided hemiplegia indicated the desirability of encephalography, which was attempted but was not satisfactory. Thinning of the dorsum sellae and flattening of the sella, as outlined on the film, indicated high intracranial pressure. Increased diploic vessel markings were incidental findings.

The EEG tracing indicates the extent to which the cerebral tissue was affected by the presence of this tumor. There is a delta focus in the left frontal area but the entire left side is involved. It is of interest to note that the frequency of the delta waves changed in the lateral aspect of the frontal lobes, compared to those found in the superior aspect. At autopsy, a large dumbbell-shaped fronto-parietal meningioma with two extensions, one dorsal and one toward the sylvian fissure, was removed from the left anterior cranial cavity.

Case III is that of a white boy, three and a half years old, whose vomiting, headaches, and regression to infantile behavior, coupled with hypotonia of the right lower extremity, were considered clinical indications for ventriculography (Fig. 5). The marked symmetrical dilatation of the lateral ventricles (Fig. 6) and the anterior tilt to the dorsum sellae suggested either a



Figs. 5 and 6. Case III: Ventriculograms showing (left) dilatation of lateral ventricles and (right) depression of dorsum sellae.

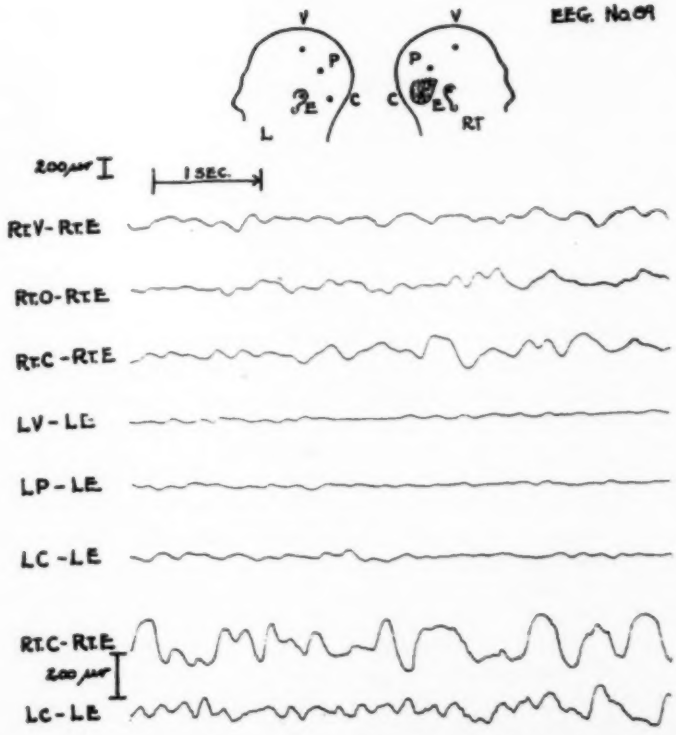
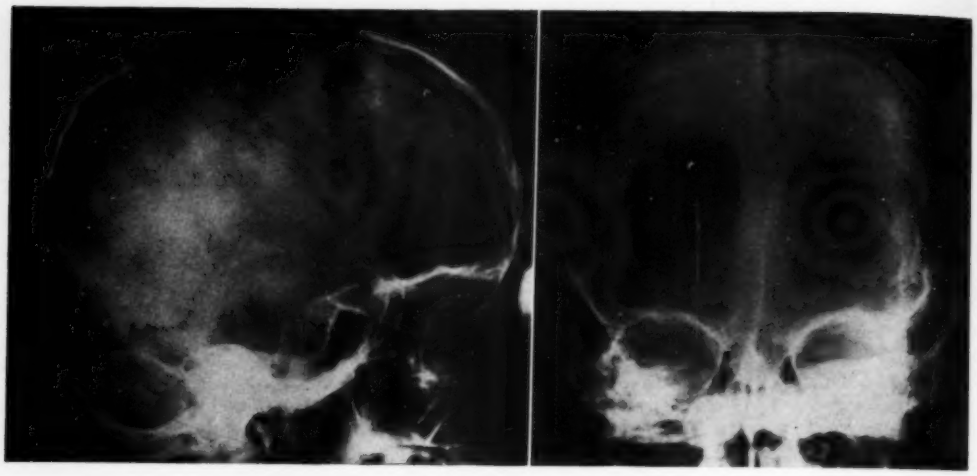


Fig. 7. Case III: EEG. Note difference of sensitivity of amplifiers from Fig. 2. Bottom pair of records at increased sensitivity. Delta focus in RC-RE tracing (single-channel amplifier used).



Figs. 8 and 9. Case IV: Routine lateral film of skull (left) demonstrates suture separation, increased convolutional depression, and sphenoidal protrusion of the sella. Ventriculogram (right) shows extensive symmetrical dilatation of lateral ventricles.

tumor or an obstruction in the subtentorial region. The EEG (Fig. 7) demonstrates a delta focus over the right cerebellar region.

At operation, the vermis appeared flattened and gliomatous, but no biopsy was taken. The impression is that this was a right cerebellar and vermis medulloblastoma. Since it is rare that the EEG is clear in the localization of a cerebellar tumor, we present this case to suggest that it may at least occasionally be so. It may be that in this instance the thin skull and the still immature condition of the skull sutures, which were undoubtedly separated by the high intracranial pressure, were responsible for the ease with which the EEG showed a delta focus. The general low voltage of the electrical tracings was perhaps related to the 5–6 diopters of papilledema that was present at the time of testing.

Case IV is one in which the diagnosis of a cerebellar lesion is suggested by indirect evidence in the EEG tracing. A 12-year-old white boy, with a two-year history of frontal headaches and visual impairment, showed left ataxia and slight right adiadokocinesis. Bilateral Babinski, as well as Chaddock signs, were present, accompanied by 2–3 diopters of papilledema and optic atrophy.

The routine roentgen films (Fig. 8) of the skull demonstrated a rather marked degree of increased intracranial pressure change with suture separation, increased convolutional markings, and remarkable sphenoidal protrusion of the sella turcica, with thinning of the dorsum sellae. The ventriculogram (Fig. 9) shows extensive symmetrical dilatation of the lateral ventricles, indicating some obstructive lesion in the subtentorial region.

It was unfortunate that no cerebellar leads were taken in the EEG study (Fig. 10), but it can be noted that the sudden bursts of high voltage slow waves in the left occipital and also the frontal areas suggest, from the experience of Smith (11), 1940, a left cerebellar lesion. A further contributing observation in this case is that there is a fast frequency present in the frontal and premotor areas on both sides, but that it is far more dominant in voltage on the right side. The frequency of this pattern, about 22/second, is close to that obtained by Walker, 1938 (12), in his recordings of the electrical activity of the cat's cerebrum during stimulation of the cerebellum. The area dominated by this frequency in this case also corresponds to that which the fibers of the dento-rubro-thalamico-cerebral nervous path projects. We therefore

arrived at the tentative assumption that these fast frequencies were the result of a pathological activity produced by a lesion lying along the cerebellar-cerebral route just outlined. We also questioned if, in this case, the presence of the pyramidal tract signs in the neurological examination could be the result of the pathological activity in this tract interfering with the cerebral motor activity. From the clinical and x-ray evidence alone, it is our impression that this is an astrocytoma of the vermis of the cerebellum extending anteriorly into the pons. No autopsy or operative report is available, however, to substantiate this opinion.

Case V: One may ask what conclusion could be drawn if the reference lead on one of the ears were itself located over a temporal lobe tumor rather than over normal tissue. Such a case was seen in a 54-year-old white female who was admitted to the hospital with vomiting, right-sided weakness and hyperactive reflexes, motor aphasia, and right homonymous hemianopsia.

The first encephalogram showed a little shift to the right, with some depression superiorly and laterally of the temporal horn of the left ventricle. Examination was repeated one month later and showed increased distortion of the left lateral ventricle with further shifting of the septum, findings pointing to tumor in the region of the precentral gyrus superior to the sylvian fissure.

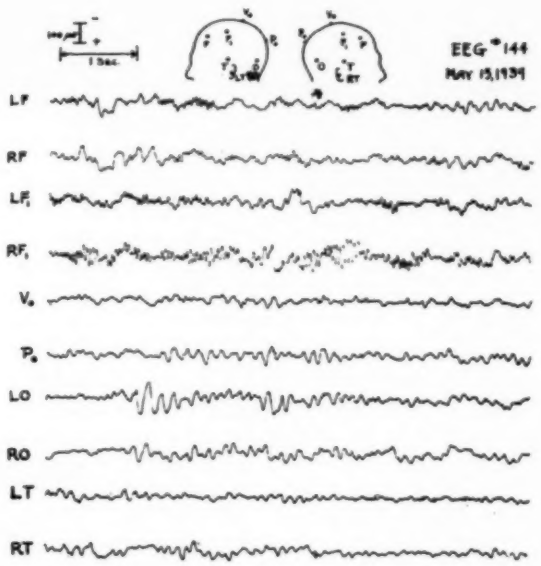


Fig. 10. Case IV: EEG. Note presence of delta waves but lack of delta focus. There is a 22/ second frequency dominant RF_1 tracing. Sudden alpha burst in LO tracing. Each corresponding pair of leads from the two hemispheres taken on simultaneous ordinates. Two channels of amplification used. All tracings to both ears as inactive lead.

The EEG showed that the entire left side had nearly equal delta patterns. Since it was unlikely that the whole hemisphere was occupied by a tumor, other combinations of leads were tried. It was discovered that a lead over the left temporal lobe of the brain near the ear, when compared to the left ear, gave no signs of a tumor. The other left scalp leads, when compared to each other or to the right ear, were also

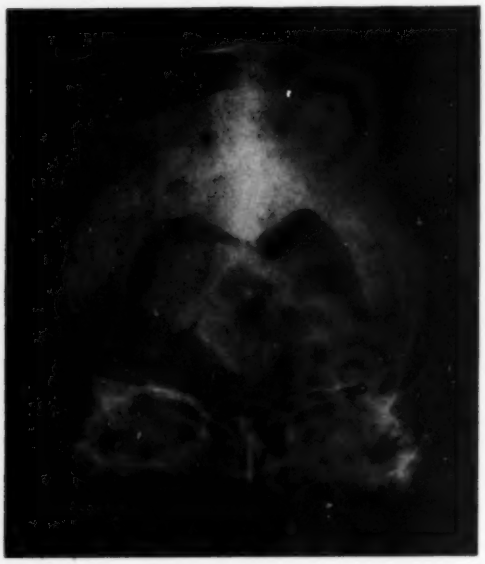


Fig. 11. Case VII: Encephalogram showing lateral and third ventricular shift, with distortion of the right lateral ventricle.

free of this sign. The record from the left temporal lobe to the left ear can be explained on the basis that both leads are on the areas that changed voltage in the delta range synchronously. Consequently, there was no potential difference of this frequency to be recorded between these two electrodes. The other left scalp leads to the right ear show no delta activity, indicating that the delta wave came from the left ear lead. We concluded, therefore, that a delta focus existed only in the left temporal area.

At operation, a posterior left temporal lobe glioblastoma was found which extended anteriorly up to the tip of the lobe, dorsally to the sylvian fissure, and deep to the internal capsule.

In *Case VI* we present from the EEG standpoint another type of localization. The patient was a white boy, 11 years old, who, following an injury to the left mastoid region, developed Jacksonian convulsions which remained confined to the right arm. Consciousness was retained throughout all attacks.

An encephalogram revealed no gross abnormality in the ventricular system, no tumor shadow, and no abnormality of the sella turcica. The ventricles, however, lacked detail because of inadequate filling.

The EEG tracing showed that even under dilantin, which clinically controlled the patient's convulsions, it was possible to obtain an epileptiform discharge which remained confined to the arm area on the left side of the head. This subclinical discharge on the EEG started in the left arm area as a 300 μV alpha rhythm of 10 cycles per second. With time, the frequency slowed to 2.6 cycles per second at 500–700 μV. During this period, the left occipital activity was found to be normal. With the command to open and close the eyes, the patient responded and the occipital alpha was suppressed in normal fashion during the interval the eyes were open. During the last portion of the subclinical discharge, a study was made of the left leg area, 3 cm. superior to the zone of the epileptoid firing. While the arm area was displaying 700 μV slow waves, the leg area, 3 cm. away, was showing its usual characteristic tracing. The entire discharge lasted 4.7 minutes. When the abnormal discharge was not present, frequent spikes of 1/10–1/15 of a second's duration and 150 μV were present in both the left arm and leg zones.

At operation, a milky arachnoid was found throughout the area which displayed this spike pattern. It was apparent that an arachnoiditis had been the precipitating factor for the local convulsive activity. We think that this case illustrates an important contribution which EEG tracings have already made; namely, that since the technic is based upon the physiological activity of the cerebral cortex, it is possible to study and classify brain disturbances which may not depend entirely upon gross cerebral pathology for their presence.

Case VII: In this last case, we want to illustrate the effects of sleep upon an abnormal EEG. The encephalogram (Fig. 11) showed shifting of the lateral and third ventricles to the left of the mid-line. The left lateral ventricle is normal in size and

shape; the right is distorted as a result of pressure from the region of the right frontal lobe. This evidence suggests a right frontal lobe tumor. Stereoscopic skull plates showed a shift of the pineal gland 5 mm. to the left of the mid-line.

therefore, that the subcortical white matter was markedly disturbed by the brain lesion. At operation, a right frontal osteoplastic bone flap revealed dura under tension. The cortex, when exposed, contained a cellular surface tumor, 2 × 1 1/2 inches,

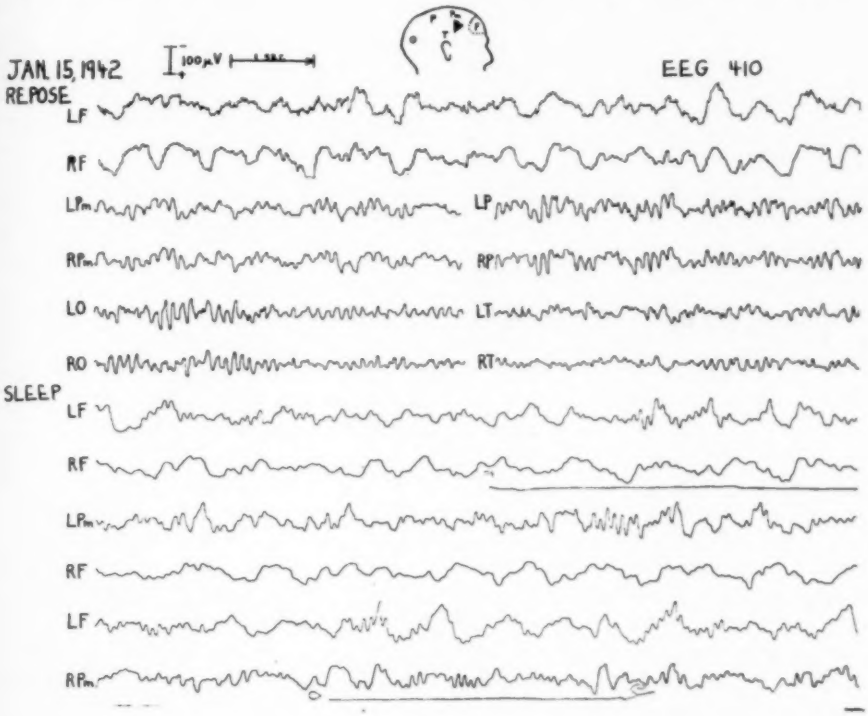


Fig. 12. Case VII: EEG. Paired records with simultaneous ordinates. Note coupling of records on second and third pairs to conserve space for records of sleep shown below. The wavy line under the eighth and last lines indicates the command to "open eyes" at start of line and "close them" at end of line. Patient did not respond to command. Note out-of-phase activity of the delta waves in RF related to LF, as well as lack of delta focus, during sleep. In top pair of records Fs are in phase and show delta focus in RF during repose. Note presence of 14/second spindles in LF, L Pm and R Pm tracings during sleep and their absence in L Pm tracings. On the diagram of the head the area outlined in dots = delta focus; the barred area, the actual clinical localization.

The electroencephalogram in this case (Fig. 12) shows a typical delta focus in the right frontal area, but little or no delta focus in the right premotor zone. With natural sleep, it can be seen that the right frontal lobe fails to show the normal 13–15 cycle/second activity shown by the left hemisphere. From experimental evidence in the dog (unreported), we recognize this loss to be significant of a disruption of the thalamocortical pathways. We suggested, replacing two premotor convolutions. The tumor was removed to a depth of 3/4 inch, at which point it was not vascular and appeared to be an astrocytoma. It extended deeper under the motor cortex, but any extensive surgical interference was considered unwise.

THE PETROGRAPHIC MICROSCOPE

The petrographic microscope is shown in Figure 13. Essentially, this instrument

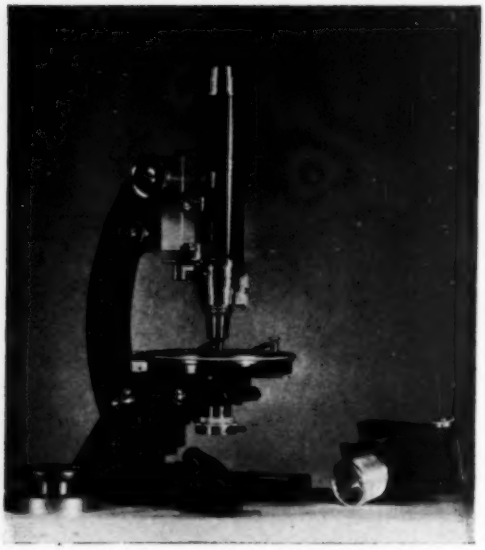
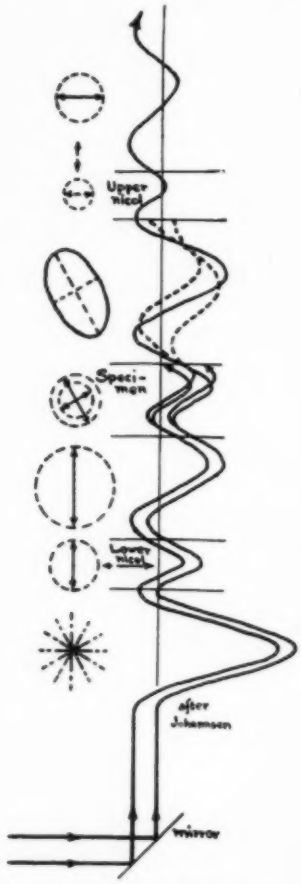


Fig. 13. Petrographic microscope.

differs from the ordinary microscope only in that it operates on a beam of plane-polarized light. Fresh or formalin-fixed specimens are used without any staining or chemical treatment whatever, and these colorless specimens stain themselves with bright and contrasting colors of light itself. The colors are formed from the interferences of the submicroscopic components of the material, somewhat after the manner of the appearance of a rainbow from colorless water droplets. These bright interference colors, the angles at which they appear and disappear, and the changes through which they progress as the specimen is rotated in the beam of polarized light, are all characteristic of the specimen itself. Consequently, in addition to showing the form of the specimen, they tell of minute physical and chemical changes which may have occurred in the tissue, with impairment of functional properties but without noticeable change in the cells or fibers.

Figure 14 is a diagrammatic representation of the path of a beam of light passing through this optical system. Ordinary white light, which is vibrating in all possible directions perpendicular to its direction of propagation, enters at the bottom, and passes through what is called a nicol prism in which all of the directions of vibration except those occurring in one plane, are eliminated. In the uppermost end of the microscope barrel, just below the ocular lens, there is a second identical nicol



From Johannsen

Fig. 14. Schematic representation of a path of light passing through the petrographic microscope.

prism, which is set with its plane of optical vibration perpendicular to the one in the substage. Consequently, light which passes through the first prism and continues unimpeded up the barrel of the microscope will not pass through the second prism, and with the nicols set in this position and

no specimen on the stage, the field appears dark.

The specimens in which we are particularly interested, however, are optically active; that is to say, they have within themselves the power to rotate the plane of polarized light. If, for example, a section of brain or nerve tissue is placed on the stage, part of it, or perhaps all of it, will appear lighted in the dark field. The stage of the microscope is mounted on ball bearings, and if now we rotate it with the specimen on it, the optically active parts of the specimen will appear and disappear as the angle changes. The precise angles at which the specimen becomes dark are called the angles of extinction, and are exactly characteristic of the substance.

In addition, these specimens all have the quality of birefringence; that is, they have two optic axes of unequal length. Such a specimen is illustrated in the diagram. This fact gives us a great advantage in that we can add an accessory plate to our optical system, just above the objective and below the upper nicol prism. When we do so, our specimen appears brightly colored in a field of colored light, as shown in Figure 15, which is a section of normal human dura. The red-violet color of the background is due to the optical activity of an accessory plate developed in 1812, and known as "Biot's sensitive violet" or, in more modern terminology, the "first order red" plate. The colors in the specimen are due to the fact that the normal dura consists of two layers of fibrous tissue of equal optical activity and equal thickness. At the point from which this specimen was taken, these layers are oriented at almost 90 degrees to each other. Since their optical activity adds algebraically to that of the accessory plate, one layer appears yellow and the other blue-green. These colors, the angles at which they appear, and the order in which they appear are characteristic of the material being studied. Any change from the normal appearance of these colored images is conclusive evidence of damage in the submicroscopic structures, whether or not the microscopic form of the cells and fibers remains normal. Where these two fiber layers of equal optical activity overlap, the background color is restored, except for the fact that some absorption takes place and the background light is not so bright as it is in the unoccupied portion of the field. If the specimen were rotated 90 degrees, the two layers shown would interchange their coloring.

Figure 16 illustrates the use of the petrographic microscope to demonstrate minimal damage in brain tissue of experimental animals. The section on the right (16B) shows a normal myelinated tract fanning out into a gyrus of a dog's brain. The section on the left (16A) is identical with that on the right as to position in the brain, except that it was taken from the opposite hemisphere, which had intentionally been damaged with an excessive dose of radiation. It will be seen that the myelin on these fibers has lost its optical properties.

There are a number of direct advantages in the use of this method for this type of investigation. In the first place, extremely slight damage can be detected, and damage found in this way can be shown to check with the behavior of the animal. In addition, since the microscope uses fresh sections, an observation can be made either on autopsy material or on biopsy material within a matter of a few minutes. Perhaps most important of all is the fact that since no staining and no chemical processing are involved, the specimen is not changed in any way after being removed, and, further, the method is not subject to great variations in personal technic, as are the usual staining methods for brain and nerve tissue.

Figure 17B shows an old, extensive lesion due to a brain injury, with complete loss of all myelin, and a pia-glial invasion, forming a scar extending from the upper left to the lower right through the center of the section. Figure 17A shows a thin fibrous membrane of the leptomeninges containing numerous capillaries and also showing star-shaped tufts of fibers which form the points of attachment of this membrane.

Figure 18 was taken at 970 diameters of optical magnification and shows in the center of the field a phagocytic compound granular fat cell which contains a number of optically active myelin ovoids. These cells appear in an area of brain damage and clean up the myelin débris. The age of the injury can often be determined by the number of these cells and the relative amount of optical activity contained in the cell. In a progressive lesion, such as one due to radiation damage, the progress of the lesion may be determined by studying these cells.

Figure 19 shows two different types of meningiomas. This type of investigation has not progressed to a point where it can be employed to the exclusion of other methods, but there is sufficient evidence to give us reason to believe that this method may, in the future, give us a great deal of vital information as to the nature and origin of some types of tumors. Figure 19A is from a known case of simple benign meningioma, while Figure 19B is from a patient whose clinical progress and history lead us to believe that this is a malignant meningioma.

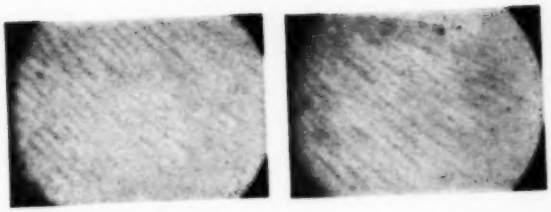
Figure 20 shows biopsy tissue from a patient who received x-ray therapy for a brain tumor (14). Radiation therapy of a 200- and a 400-kv. quality was given in doses of about 200 r per day for a period of 30 days. Four fields were used, a right and a left temporal, a left frontal, and a left vertical. These fields, each 10 × 10 cm., centered on the left frontal lobe, in which the patient had a recurrent malignant meningioma which had been proved by operation. Each surface area received about 2,000 r measured on the surface. The calculated tumor dose was 2,943 r.

The first operation on this patient was performed April 1, 1939, and radiation therapy was administered during July and August of the same year. A second operation was performed Feb. 6, 1941, at which time this biopsy specimen was taken with the remains of the tumor. Figures 20B and C are actually the same point in the white matter of the brain with the slide rotated 90 degrees between photographs. It will be seen that there is slight indication of a myelinated tract and slight indication of optical activity, but in general the optical activity of this section of the brain is destroyed. In Figure 20A, we have the margin of the lesion at the very bottom of the photograph. A few remnants of myelinated tracts may be seen, while in the upper portion of the field almost nothing can be seen other than myelin débris.

The therapeutic radiation procedures used on this patient represent accepted technic, but the illustration clearly indicates that the minimal amount of radiation which can be expected to damage the tumor will also do extensive damage to the brain, and hence that the smallest practical portals of entry must be used and radiation fields be judiciously chosen to keep the unavoidable damage to normal brain structure at a minimum.

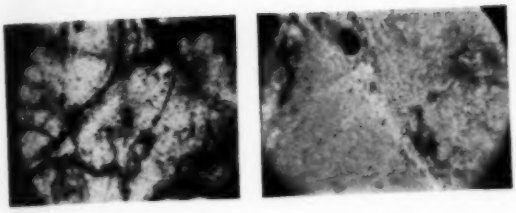
In this presentation, it is not possible for us to go into greater technical detail about the physical operation of the microscope. This is, in itself, a long and involved subject, and we must refer those interested to any one of a number of standard books on the subject (15). Neither is it possible for us to go into a full discussion of the practical applications of this instrument to the study of normal human tissue. For example, we might point out that the axis cylinders of nerve fibers are also optically active. They are of opposite optical sign to the myelin that we have shown, and of a somewhat lower order of birefringence. Consequently, in the myelinated tract, it is largely the myelin itself which appears. We have, however, found that in extensive brain damage the myelin tract may degenerate to the point where the myelin itself is no longer in evidence and only the axis cylinders remain. We have presented such a case in a previous publication. This demyelination, of course, represents a midpoint in extensive brain damage, as with further injury, or in injuries which are allowed to go for a long enough time before biopsy, it is found that the axis cylinders themselves have degenerated.

Fig. 15.



A B

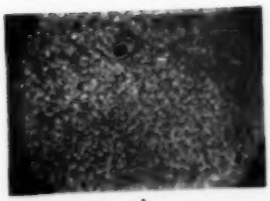
Fig. 16.



A B

Fig. 17.

Fig. 18.



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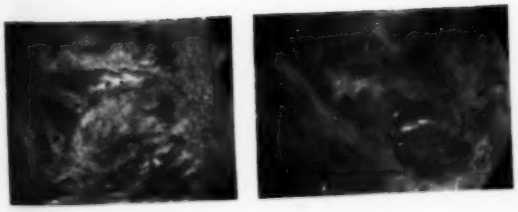
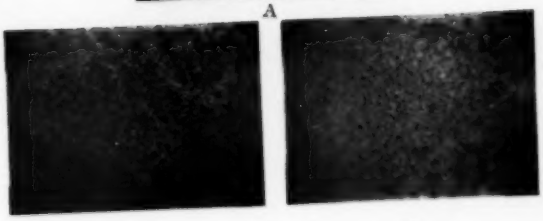


A B

Fig. 19.



B C

Fig. 20.

The use of this instrument in the study of glandular and other tissues to which it is applicable, we will have to leave for another time. We can say, in passing, that the field of application of the petrographic microscope is extensive and, at the same time, sharply delineated, for while many of the tissues of the body are subject to study by this method, some of them definitely are not. It is interesting to note that, while other scientists have employed this instrument in analytical and investigative procedures for over one hundred and fifty years, its use in the field of medicine has only now begun.

SUMMARY

The EEG offers us a valuable adjunct for the determination of the presence and the location of cerebral lesions. It is also of use in the determination of some cerebellar tumors. In the latter circumstance, however, indirect evidence may be all that is present to indicate the neoplasm. It contributes materially to the study and location of certain types of lesions that do not produce gross anatomical disturbances.

Petrographic studies yield facts about the submicroscopic structure of tissue changes present in brain lesions by illustrating the patterns of fibrosis, the extent of myelin damage, and the organization of the crystalloid structure in the pathological tissue without the changes necessitated by histochemical methods.

NOTE: We wish to express our great appreciation to Stephen Bohn, M.D., for the neurological examinations; to E. S. Gurdjian, M.D., for the autopsy reports on the EEG cases; and to Rollin Stevens, M.D., for the clinical and radiation history and the biopsy material presented in the human case studied by the petrographic microscope.

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DISCUSSION

(Papers by Edwin Boldrey; V. C. Johnson and F. J. Hodges; E. R. Witwer, A. J. Derbyshire, and K. E. Corrigan)

Howard C. Naffziger, M.D. (San Francisco, Calif.): It is a privilege, a pleasure, and a very stimulating experience for a neurological surgeon to have the opportunity of attending these meetings. The two specialties, neurological surgery and roentgenology, have progressed hand in hand. They have been mutually interdependent, I think extraordinarily so. The advance of neurological surgery in the diagnosis and treatment of brain tumors particularly is the result of the technical methods available in the field of roentgenology. In comparing the differences between the neurological surgery of thirty years ago and that of the present, it is obvious that no symposium such as we have enjoyed today could have been held then. Thirty years ago the point of view of the neurological surgeon was narrow; the occurrence of intracranial pressure was his principal concern. At that time we were in the stage of doing decompressions. In America it required many years for a realization of the fact that

to open and close the cranial cavity in the presence of high intracranial pressure was hazardous and frequently fatal if the cause of this pressure was not removed. Long before, Horsley, with less refined surgical methods, removed many brain tumors, with a mortality lower than that which prevailed in this country during the period characterized by decompressions without the removal of tumors. We were slow to learn that pressure must be reduced if the patient is to have a satisfactory convalescence. During the same period, both in Europe and in America, pituitary surgery was performed by the nasal route. Later the intracranial operation was generally adopted, with vastly improved results. A great impetus came with the adoption of air injections and the ability to localize the tumor.

Other contributions to neurological surgery have been the improvements in anesthesia and in electrosurgery.

When the problem arises, "Has this person a tumor?" three queries must be answered. First, can the neurological picture be accounted for by a *single* lesion? If it can be explained by a single lesion rather than by multiple processes, we ask: "Is there evidence that this lesion is progressive as shown by such signs as increasing paralysis, difficulty in speech, or progressive loss in the fields of vision?" If these two criteria are met, first a single lesion and secondly a growing lesion, tumor must be considered. Then, if the third manifestation appears, namely, evidence of pressure as shown by examination of the eyes, roentgenography, etc., confirmation of the diagnosis of tumor is unmistakable. If there is a tumor, we must know where and what it is. The increasing frequency with which we can answer these two questions correctly indicates the great advances which have been made.

Added methods of examination, such as Doctor Witwer has presented, and particularly electroencephalography, appear to have a very distinct field of usefulness. Electroencephalography does not overlap nor, so far as we can judge, will it take the place of air injections. As Doctor Witwer pointed out, the waves that you see are waves from the brain. They are disturbed by a nearby lesion but are not from the lesion itself. It has been our experience that electroencephalography is of considerable help in the diagnosis of brain tumors. In the differential diagnosis of gross lesions, such as tumors, scars, or abscesses, however, the information it yields does not compare with that obtained from air injections. On the other hand, when dealing with functional disturbances of the brain not associated with a gross lesion, as in convulsive states, or when there is no demonstrable lesion at all, the electroencephalogram is useful in demonstrating the dysrhythmias.

As our knowledge of the favorite locations of the numerous pathologic types of tumors has become more accurate, our ability to forecast the diagnosis by minute radiographic findings has increased. This predilection of neoplasms for special sites affords the radiologist valuable clues to pathologic diagnoses. It is an interesting observation that, although neurologic diagnosis is more exact than the diagnosis of other body systems, roentgenologic diagnosis has quite outstripped it in certain ways. The neurologist can frequently place a tumor in the arm center on the right side. The surgeon, however, needs to know more than that. He isn't pleased to uncover the arm center and find it appearing normal on the surface—and wonder where to go next. After the injection of air, the roentgenologist can usually tell him whether the growth originated farther forward and is extending backward to the arm center, whether it is postcentral and growing forward, or whether it is deep and coming toward the surface. Additional advances in neurology have come from improved methods of diagnosis and will continue to do so. The debt we owe to the radiologist is gratefully acknowledged; the association has been particularly profitable and pleasant.

Eugene P. Pendergrass, M.D. (Philadelphia, Penna.): It is a great satisfaction to read and study a paper like Doctor Boldrey's. He, and others, are making valiant efforts which may ultimately render it possible for the radiologist to diagnose with increased assurance the nature of underlying pathology in intracranial lesions. He calls attention to calcification in the cyst of glioblastoma multiforme. He points out that astrocytoma grows more slowly, and grows frequently from the corpus callosum. He states that oligodendroglioma is of slow growth, and that the patients are usually around thirty years of age. The tumor is frequently calcified. I am not sure whether there is a difference between the calcium pattern occurring in glioblastoma and that of astrocytoma and oligodendroglioma. Further study will be necessary before such a differentiation can be made. Ependymoma should be differentiated from a cyst of the septum pellucidum.

In encephalography, gliomas show a tendency toward loss of the cerebral (subarachnoid) pathways. The deformity of the ventricles is usually concave as differentiated from lesions that occur in the surface of the cortex, which cause flattening of the ventricle. Calcification occurs more frequently in gliomas than in any other group, and the calcification may be found either in the stalk, in the walls of the cyst, or in the tumor. The calcifications occurring in the stalk or nubbins of the tumor are likely to be dense and homogeneous, whereas in the tumor the pattern of calcification is quite different.

In the meningiomas the bone changes are bizarre. They may be of the textbook type, showing perpendicular striation, or they may show a rather uniform density, or the change in the bone may simulate that produced by osteomyelitis or by erosion from vessels. Normal bone diploe changes, when

they occur, are usually bilateral; when bone changes are unilateral something abnormal is to be expected. In meningiomas, one should bear in mind the changes that occur in the region of the hypophysis or the lesser wing of the sphenoid.

After encephalography the deformity of the ventricle is usually a flat deformity, in contrast to the concave deformity produced by the subcortical gliomas. The subarachnoid pathways are usually absent on the affected side in meningiomas and absent on both sides in gliomas.

In the chromophile adenomas enlargement of the hypophyseal fossa occurs, with increase in the depth and width. These changes should, when possible, be differentiated from the hypophyseal changes produced by extrahypophyseal lesions. If the pituitary tumor is large, the dorsum may be completely absent and the picture will thereby simulate an extrahypophyseal lesion. With an eosinophilic tumor the hypophysis is usually large, with an increase in the depth and width of the fossa. In these lesions, however, the dorsum sellae is usually always present.

The so-called Rathke's pouch tumor or craniopharyngioma is classified by us as a stalk tumor. The Rathke's cleft cyst, which we think is entirely different from craniopharyngioma, never calcifies, is rare, and can be diagnosed only by microscopic examination, because such lesions are lined with ciliated epithelium. The cyst is usually located in the cleft between the anterior and the posterior lobes. The stalk tumor, however, represents the remains of the craniopharyngeal stalk and the lesion may occur in the pharynx, in the sphenoid sinus, in or above the hypophysis. This lesion frequently shows evidence of calcification.

It is not within the province of this discussion to take up the therapy of pituitary tumors, but I should like to sound a warning concerning one danger. When roentgen therapy is given to pituitary lesions, one should be sure to warn the patient, the neurologist, and the neurosurgeon of sudden blindness, which may occur as the result of a rapid increase in the size of the cyst. When this occurs, immediate operation is necessary to relieve the tension on the optic chiasm and the blood vessels in that neighborhood.

In the angle and acoustic tumors, if the lesion is on the side in which there is a large venous sinus (lateral and sigmoid), the symptoms are likely to appear sooner than when the lesion is on the side of a small venous sinus, because of the ability of collateral or compensatory circulation to occur in the latter whereas it does not occur in the former situation. Dermoid lesions in the posterior fossa often have a stalk which may penetrate the table of the skull in the region of the torcular Herophili.

The paper of Doctors Hodges and Johnson is a difficult one to discuss. One envies Doctor Hodges in having available the mechanical calculating equipment which provides him with an unusual opportunity to present data to the Society such as he has presented today. However, I would suggest that this report be supplemented by the following data, in subsequent papers:

1. The number of gliomas showing calcification.
2. Is there any constancy in the pattern of calcium occurring in different kinds of gliomas?
3. The number of other cases showing calcium.
4. The number of cases showing bone erosion.
5. The number of cases showing displacement of the pineal body and choroid plexus.
6. The number and age of patients showing increased digital markings.
7. The number and age of patients showing widening of the sutures.
8. The number of cases showing cell erosion with relation to the position of the lesion and length of symptoms.

I believe it is very important for Doctor Hodges and Doctor Johnson to analyze critically the cases missed by the various procedures that they have described this morning, by giving the following information:

1. Why was the diagnosis missed?
2. Were mistakes made?
3. Could one review the cases and prevent similar mistakes from being made in the future?
4. Would combined encephalography and ventriculography or arteriography have increased the "batting average"?

I want to congratulate them on the beginning they have made, and ask that they follow this up with additional data.

The procedure of arteriography has made it possible for the radiologist to demonstrate aneurysms and other lesions that have been missed completely in the past. I have had very little experience, and am therefore not competent to give an intelligent discussion of Doctor Witwer's paper. Electroencephalography is a procedure the technic of which is based upon the physiological activity of the cerebral cortex. It should be valuable to clinicians to determine the site of the major physiological disturbance, no matter to what it may be due. After greater experience, the neurophysiologist may be able to obtain more information from such studies.

The use of the petrographic microscope may have a real function to play in demonstrating the small changes produced by ionization within the tissues, which are not observed by the ordinary microscopic examination. If that becomes practicable with various sized doses, we may then be able to develop therapy technic on a scientific basis instead of the empirical method now employed.

Physical Examination at Induction

Standards with Respect to Tuberculosis and Their Application as Illustrated by a Review of 53,400 X-Ray Films of Men in the Army of the United States[1]

ESMOND R. LONG, Lieut. Colonel, M.C., A.U.S., and WILLIAM H. STEARNS, Capt., M.C., A.U.S.

THIS PAPER IS concerned with that section of the Army standards of physical examination having to do with diseases of the chest, particularly tuberculosis, and their application, as shown by a review of 53,400 chest x-ray films of inducted men.

The standards for chest disease were prepared by the War Department with the advice and assistance of a subcommittee of the Division of Medical Sciences of the National Research Council, in conformity with a general practice of the War Department in the formulation of physical standards. Since the August 1940 edition of Mobilization Regulations, several modifications have been adopted as the need for certain changes has become evident. Inasmuch as definite standards in regard to acceptable and non-acceptable tuberculous lesions inevitably invite criticism, it might be well to examine the steps through which the present standards were evolved.

Originally, in 1940, the primary concern of the committee was that x-ray examination of the chest be made an integral part of the physical examination of every man before acceptance by the Army. The standards, as proposed at that time, while specifying that all active cases of tuberculosis should be excluded, did not define limits as to the size and number of healed lesions which might be considered acceptable. Rather, certain broad principles were set forth and much was left to the judgment of the individual examiners. In theory, this would seem to be the logical and perhaps ideal type of directive. It became evident, however, as the speed of mobilization increased, that it was necessary to adopt quite arbitrary standards rather than expect examining physicians to rely on quick judgment in the thousands of cases showing evidence of apparently healed or inactive lesions. These arbitrary standards, which permit the acceptance of certain inactive states, are based in general upon the size and number of lesions. As will become apparent later in this discussion, the conspicuously arbitrary nature of the limits has been tempered by certain provisions of the present standards. These will be discussed in relation to the infiltration of tuberculosis of re-infection type and then in respect to the calcified lesions of healed primary tuberculosis.

Limits for healed, infiltrative tuberculosis are both qualitative and quantitative. In the first place, to be acceptable such inactive lesions must present a strand-like or dense nodular appearance and, according to the expressed provision of MR 1–9, may not exceed a total area of 5 sq. cm. as projected on a conventional 14 × 17-inch film. Deferment in these cases is required until "subsequent examination demonstrates that the lesion is stationary and not likely to be reactivated." It is stated that the minimum period of time to determine this is six months, that it must be recognized that either progression or regression of the lesion indicates instability, that clinical judgment, taking into consideration other factors, including age and race, must be exercised in estimating the likelihood of reactivation, and finally that experience indicates a greater likelihood of reactivation of a lesion that appears to be stable in persons under twenty-five years of age than in older persons.

In this connection, it should be observed that, in the general preface to the outline of physical standards, it is specifically stated that examining physicians are to consider the standards as a guide to discretion, not to be construed too strictly or

[1] Presented before the Radiological Society of North America at the Twenty-eighth Annual Meeting, Chicago, Ill., Nov. 30–Dec. 4, 1942.

arbitrarily. It may be assumed that this provision applies to all sections of the Regulations, including that devoted to the chest. Whatever may be the defects of the regulation on deferment, to which reference was made in the preceding paragraph, practically it has proved useful and it is believed few cases of tuberculosis have developed from lesions of extent and character considered acceptable after the required period of deferment.

With regard to standards for primary lesions, the situation is somewhat more complex, since there are two conflicting schools of thought on the pathogenesis of reinfection type tuberculosis. On the one hand are those who believe the incidental finding of large or extensive calcified residues of primary tuberculosis is of little or no significance for the future, possibly indicating unusually high, or perhaps even enhanced resistance, and on the other, those who feel that large and numerous calcified residues are evidence of a massive infection, not necessarily entirely healed and possibly associated with unrecognized lesions elsewhere in the body. The occasional finding of a caseous center containing living tubercle bacilli on section of large, apparently well calcified nodules and nodes has been cited as evidence of the latent danger of such lesions.

After numerous requests for exact specification of limits for acceptable calcified lesions, standards were set "arbitrarily to provide an objective basis on which the examiner may render a decision." These lesions were defined as follows, all measurements referring to single, standard 14 × 17-inch direct projection roentgenograms:

"*a.* Calcified residues of lesions of the intrathoracic lymph nodes, provided none of these exceeds an arbitrary limit of 1.5 cm in diameter and the total of such lesions does not exceed five.

"*b.* Calcified lesions of the pulmonary parenchyma, provided the total of these does not exceed ten; and one of these may equal but not exceed 1 cm in diameter; but none of the remainder may exceed 0.5 cm in diameter."

It was specified that in the roentgenogram such calcified lesions should appear isolated, sharply circumscribed, homogeneous, and dense.

As a result of such exact mathematical limits, decisions as to acceptance or rejection were reached mechanically in many cases rather than clinically. In succeeding months complaints were received from all parts of the country that men who were perfectly healthy had been kept out of the Army by rigid interpretation of the standards. This was perhaps inevitable in view of the exact limits set forth in the Regulations and in the absence of qualifying statements. Therefore, in a subsequent revision, dated Oct. 15, 1942, a paragraph of explanation was added with respect to the calcified lesions. Quotation of a single sentence from this paragraph will serve to show the liberalizing effect of the revision: "Further consideration may be given to the acceptability of persons with calcified lesions of this type (*i.e.*, in excess of the arbitrary limits) where the state of health in all respects clearly warrants the opinion that the lesions in question are healed." The type of consideration to be given, clinical in character, was then indicated.

In summary, it will be remembered that the first standards left the decision with respect to these calcified lesions to the judgment of the examining physician. Then, when that approach was shown by experience to be impracticable, decision as to acceptance was put on a basis which proved too arbitrary. The present regulations represent a combination of the two approaches, the arbitrary limits being modified by the specific statement that clinical judgment is to be used and a man considered for acceptance if, after careful examination, there is every reason to believe him to be in good health and the lesions well healed. The present modification of the standards is known from personal observation to have proved satisfactory, and many men, rejected on the basis of strict interpretation of the arbitrary limits, have been recalled for reconsideration.

So much, briefly, for the standards of

TABLE I: SUMMARY OF INFILTRATIVE LESIONS FOR THE NINE SERVICE COMMANDS

Service Command	Number of Films Reviewed	Tuberculous Infiltrates					
		Total		Quest. Signif.		Significant	
		Actual	Per 10,000	Actual	Per 10,000	Actual	Per 10,000
I	4,650	21	45	16	35	5	10
II	5,550	25	45	18	32	7	13
III	7,400	44	59	36	48	8	11
IV	8,400	38	45	27	32	11	13
V	6,050	31	51	23	38	8	13
VI	3,750	8	21	6	16	2	5
VII	4,350	14	32	11	25	3	7
VIII	8,250	53	64	21	25	30	36
IX	5,000	37	74	15	30	22	44

examination. The application of these standards will now be discussed in the light of a review of 53,400 chest x-ray films representative of the men accepted at 89 induction stations in the United States during the summer and fall of 1942.

The films reviewed in this study were random samples from the thousands sent in from each induction station for filing by the Veterans Administration and are believed to provide a fair index of the quality of work at the stations at the time indicated. The great majority of the films received were 4 × 5-inch photoroentgenograms, now almost universally used by the Army induction stations. These with few exceptions were stereoscopic views, which in this type of photoroentgenography are much to be preferred to a single view. A few small stations were still using conventional 14 × 17-inch films as a routine method of screening. Paper films were used by all stations in one service command and by a few stations in another.

In general, 500 to 1,000 films from each station were reviewed. It had been hoped to read at least a thousand films from each, but the time available to devote to the project was insufficient to accomplish this. Instead, the review has been made roughly in proportion to the population of the various service commands.

The primary intent of the standards is to exclude active tuberculosis and, in so far as possible, tuberculosis likely to be reactivated under the stress and strain of military life. Unfortunately, this review would indicate that a certain number of active cases have slipped through the induction stations. The accompanying table indicates, by service commands, the ratio of such cases to the number of men inducted. On the basis of these figures one may make estimates on which plans may be based for the care of tuberculous patients by the Army and the Veterans Administration. The case rate in seven service commands would seem, however, to provide a fairer index than that of all nine service commands, as temporary local difficulties in a minority of the stations in two commands appear to have been responsible for the high rate in those areas.

For the most part, the lesions considered as significant in this review were apical and infraclavicular infiltrates of "soft" appearance, minimal in extent. Many of them seemed quite obvious, but a certain number could easily be missed unless one inspected the 4 × 5-inch views singly as well as stereoscopically. More difficult to explain is the overlooking of several cases of moderately and far advanced disease. It has been discovered that clerical errors were responsible for the induction of some of these men.

The rather consistent ratios for "significant" lesions, 10 per 10,000 for one service command, 11 per 10,000 for another, and 13 per 10,000 for three other commands, and the low rates of 5 and 7 per 10,000 for two service commands (the latter representing, incidentally, the low tuberculosis area of the United States) are believed to provide a basis for a reasonably accurate estimate as to the number of cases of

tuberculosis in the Army. As already indicated, the rates of 36 per 10,000 for one service command and 44 per 10,000 for another are misleading in view of the fact that a small number of stations were responsible for the marked deviation of the whole from the average for the country.

In addition to the apparently significant lesions, 173 infiltrates, considered to represent inactive tuberculous lesions of reinfection type, were discovered, a rate of approximately 35 per 10,000. This group of most of the lesions listed in this group may have been demonstrated before induction. Because of the lack of information, however, as to which of these lesions have been so studied, no valid comparison of the work of the service commands can be based on these figures. Further, it should be pointed out that the number of such lesions diagnosed will, at least in part, be dependent upon the technical quality of the films and the corresponding ease with which small scarred lesions are seen.

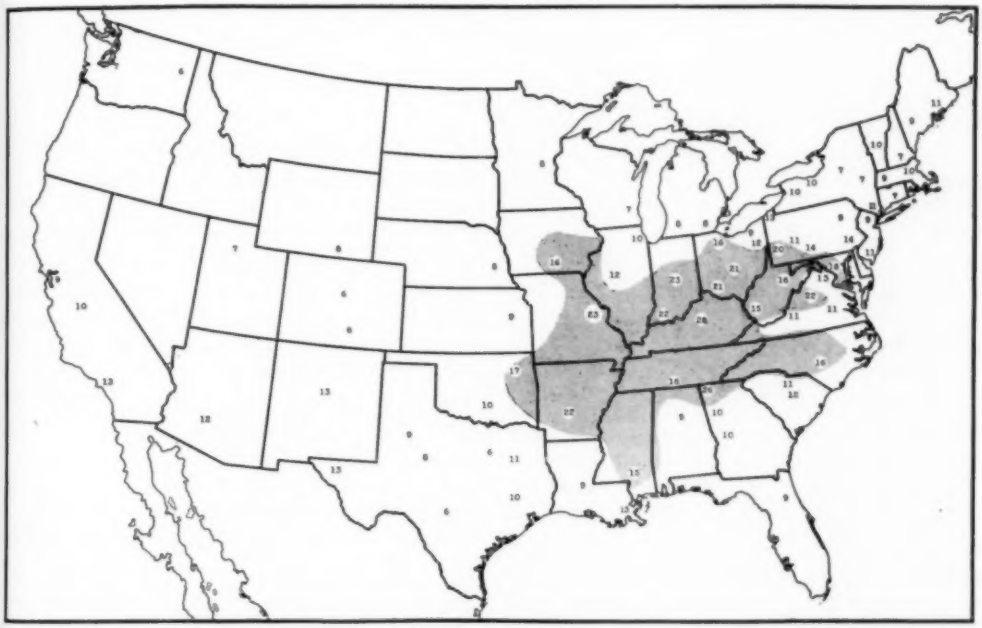

Fig. 1. Incidence of calcified lesions in chest films of inducted men from 89 induction stations. The figures represent percentages for the regions marked. In the shaded area more than 15 per cent of the films of accepted men showed pulmonary calcification.

is composed of infiltrates of a character and extent which the standards specify as acceptable after deferment until subsequent examination demonstrates that the lesion is stationary and not likely to be reactivated.

From personal observation of the work at various induction stations, it is known that men in whom infiltrates of this type are diagnosed usually are accepted only after the required period of observation; so there is reason to hope that stability

The incidence of calcified lesions presumed to represent healed tuberculosis corresponds to the now well known pattern of regional differences in the United States. High incidence (over 15 per cent) was noted in a region bounded roughly by Fort Oglethorpe, Georgia, Jefferson Barracks, Missouri, Little Rock, Arkansas, and Columbus, Ohio. In general, the calcifications noted in the films of men from this region were considerably larger and more extensive than those in men from

TABLE II: Pulmonary Calcifications
(Percentage in Films Read)

Service Command	Acceptable*	Excessive
I	8.8%	0.06%
II	9.3%	0.14%
III	13.6%	0.20%
IV	13.9%	0.29%
V	18.0%	0.55%
VI	8.4%	0.08%
VII	10.3%	0.11%
VIII	11.3%	0.23%
IX	9.1%	0.14%

* As specified in MR 1-9, March 15, 1942.

other parts of the country. Also, disseminated "miliary" calcifications, variously believed to represent healed residuals of a post-primary hematogenous dissemination of tuberculosis or perhaps, in some cases, a healed fungous infection of the lungs, seemed relatively more frequent in this area.

As the figures with respect to the calcified lesions may be of epidemiological interest to some, a graphic record of the incidence of calcification in accepted men in and around the area under consideration is added (Fig. 1).

The term "excessive" is used to indicate those calcified lesions designated as not acceptable, by reason of their size or number, under the old standards, but acceptable under current regulations, "provided the report of the physical examination and the chest x-ray films have been reviewed and acceptance has been recommended by a medical examiner specially qualified in the diagnosis of diseases of the chest."

At this point it should perhaps be repeated that the apparent emphasis on calcified lesions should not be allowed to obscure the primary intent of the standards, the exclusion of active tuberculosis and tuberculosis likely to be reactivated. Preoccupation with the easily seen calcified residuals of primary tuberculosis must not divert the examiner's attention from the small infiltrative lesions of re-infection type tuberculosis which, especially in the early stages of development, may appear only as vague and ill defined shadows, but which are of infinitely more significance for the future.

It is not considered appropriate at this time to present a detailed report indicating the results of the interpretation for each induction station. It is believed that a summary by service commands will serve the purpose of the present review, indicating those parts of the country where difficulties have arisen making possible the entrance of men with tuberculosis into the Army. It is not the intention of this paper to analyze these difficulties or make suggestions for the further avoidance of error. Needless to say, those officially concerned are informed on the results of the survey and appropriate steps are in course to avoid repetition of the errors uncovered.

SUMMARY

Roentgenologic chest standards for examination of men at induction were drawn up to prevent the acceptance of men with active pulmonary tuberculosis or inactive tuberculosis that might be reactivated by the strain of military service. Since the original formulation of the standards, several changes have been made with regard to inactive lesions. According to current regulations very small infiltrative processes are considered acceptable if their stability has been satisfactorily demonstrated by observation after a period of deferment. Small, well calcified lesions of primary tuberculosis are accepted without question, and large and numerous lesions of this type may be considered for acceptance if the subject examined is twenty-five years old or more, if the nodules are dense and discrete, and finally if thorough clinical examination yields no indication of active disease.

A study was made of the effectiveness of the examination, as revealed in films of accepted men filed with the Veterans Administration in the summer of 1942. A review of 53,400 films from 89 induction stations indicated that a certain number of cases of infiltrative tuberculosis, clearly inacceptable according to the regulations, have escaped detection at the induction stations. The number of such instances is small in two service commands, inter-

mediate in five, and large in two. Steps to remedy defects in the examination are in course.

The incidence of healed primary tuberculosis in accepted men, as indicated by the presence of calcified masses in the lungs and hilum lymph nodes, was found to vary geographically in a manner quite in accordance with current general observation, a high rate prevailing in a region in the east central portion of the country.

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Washington, D. C.

DISCUSSION

Lieutenant Colonel de Lorimier: Because of the amount of controversy relative to stipulations pertaining to chest examinations as described in Army Regulations, I believe that I should re-emphasize the point that these regulations are intended merely to serve as a guide. In case too literal an interpretation of them is made, review boards function to clear discrepancies. Credit is due particularly to Colonel Long for enforcing the most practical decisions and working upon improvements of a technical nature to provide for the highest quality of graphic records, thereby insuring the most trustworthy roentgenographic records that will later serve as legal records.

The data cited by Colonel Long indicate percentages of oversight by our Army examiners. Many of the mistakes represent liabilities for our Government. These are costly mistakes. Statistics of the last great mobilization indicate that on the average each such mistake, which leads to compensation, costs our taxpayers $10,000 to $15,000. Moreover, in many instances, there was dissemination of disease by the individuals involved resulting in a multiplication of the compensation requirements. Furthermore, most of these mistakes account for man-days lost to the Service.

Surely these studies indicate the great responsibility which rests upon doctors who are entrusted with this work. In particular, I would refer to the roentgenologist. Statistics such as those reported by Fellows and Ordway would seem to be substantial proof that few cases of minimal parenchymal lesions are likely to be identified by the use of the stethoscope—this fact in direct contrast to the trust which can be placed in roentgenography. But the data presented indicate a very considerable error even with roentgen studies. Serious deliberation about this problem prompts the suggestion that blame might be attributed to a variety of factors:

First, lack of appreciation by the individual examiner as to the real responsibility which has been entrusted to him.

Second, delay in putting into practice the long ago accepted official plan of procedure.

Third, overtaxation of the visual and mental acumen of the average pair of eyes and the human brain.

With respect to the first of these, it must be admitted that a professional diet of viewing chest films all day long and day after day is not ordinarily stimulating. To offset the doldrum character of this routine, we have attempted to encourage each officer to assemble data such as Colonel Long, independently, has accumulated. There is a wealth of knowledge to be gained from this tremendous survey. It should be possible for each examiner to obtain statistical information relative to no less than 50,000 or possibly as many as 250,000 Americans and in the end to learn of the incidence of one or another condition for various sections of our country.

Referring to the matter of delay in putting into practice the official procedure, I would remind you that there were difficulties in setting up the equipment and in distributing materials so suddenly to every section of the country. The official procedure calls for the use of 4 × 10-inch single emulsion films, providing for photographing the fluoroscopic image and viewing two images stereoscopically. The standard 14 × 17-inch films may be used to clarify doubtful evidence. Some of the examiners are known not to have viewed their films stereoscopically. Moreover, in many instances, the contrast characteristics of the photoroentgenograms have been so great as to obliterate too much.

As previously stated, for this procedure, it is the conviction of our group at the Army Medical School that higher than conventional kilovoltages should be used and that the single emulsion rather than duplitized films are needed. The importance of these factors is now being widely recognized.

At present, we do not know the limit as to the number of cases which the average person can alertly analyze in a day—and day after day. Since we doctors belong to no union, we tend to a determination of finishing any task which is set before us. In some instances we hear of a single examiner studying even more than 600 cases in a day. Personally, I do not believe that I can be trusted to analyze thoroughly more than 400 cases each day for a period of days.

Edwin C. Ernst, M.D. (St. Louis, Mo.): I have been very much interested in this most timely review of such a large group of draftee examinations, especially the roentgen evaluation of the diagnostic chest criteria set up by the Army for the interpretation of early tuberculous lung infections.

It would seem to me that the diagnostic significance of multiple sharply defined calcifications within the lung fields—excluding upper interspace apical involvements as very suspicious roentgen evidence of early tuberculosis—has been over-emphasized and that this over-emphasis has not been in keeping with the experience of many of us who are privileged to

review thousands of chest films every month. The diagnostic problem of sharply defined lung calcifications and excessive thickening of the hilar and peribronchial tree was discussed pro and con prior to our entrance into the last war. At that time the literature available upon this subject was very meager; nevertheless, those of us who saw early service in France soon realized their relative unimportance as pathognomonic roentgenologic signs of active incipient tuberculosis.

In 1917–18, at Rouen, France, Base Hospital Unit No. 21, facilities were made available for Dr. Eugene Opie and myself to examine, pathologically and roentgenologically, hundreds of lung specimens of British and American soldiers. After calcified lung fields had been "spotted" on large x-ray plates, the autopsy specimens were then minutely reexamined roentgenologically and histologically. Approximately 70 per cent of our American soldiers presented varying degrees of excessive lung calcifications as compared to but 30 per cent of the British. The reverse was true in reference to the mesenteric calcifications of autopsy specimens. Approximately 20 to 30 per cent of the American soldiers showed calcifications of the mesenteric node structures as compared to 70 per cent in the British group examined.

Time will not permit me to discuss all of the clinical interpretations of these research observations in relation to the resistance factors of acquired early or late tuberculous infections. Age, of course, plays an important role as a predisposing factor in pulmonary tuberculosis. Many other clinical factors must be given due consideration. Semicalcified indistinct fibrotic densities in the peripheral apical areas of the lung are likewise suspicious findings without controlled serial x-ray studies. Recently, however, I reviewed a large group of chest films of cement workers, made annually, in whom multiple hilar and peripheral calcifications were present, and yet not a single worker had contracted tuberculosis over a period of five to nine years, although the usual percentage of expectant tuberculous infections were noted in the non-calcified areas of relatively clear lungs.

I am happy to hear Colonel Long make the statement that the published Army calcification rules, or their roentgenological diagnostic criteria of minimal tuberculosis, are in the process of modification by official decree. Some of us have been very much embarrassed in our medical practices by the apparent arbitrary standards of diagnosis by the Army, limiting hilar calcifications to four in number, while six nodes of a given size are sufficient reason for rejection. Let us not be unmindful of the mental anguish and economic stigma which will most certainly follow many of these rejected applicants throughout their lifetime.

In a group of 24 men observed during the past month, and previously examined by me three to five years prior to their present examination, all of whom were rejected by Army Boards as tuberculosis suspects, not a single one presented suspicious history findings, and even now they show no evidence of clinical tuberculosis. These cases and hundreds of others examined each month and rejected by the Army are my reasons for questioning some of the conclusions presented in this paper.

In the light of practical experience of at least some of us in the diagnostic field of early pulmonary tuberculosis, doesn't it seem logical that the Army regulations, heretofore discussed, should be reviewed in their entirety by a competent group of internists, pathologists, and radiologists, rather than modified by means of a special communication?

Otherwise—lest we forget—what will happen to a post-war veteran if he discovers at the time of his discharge from the Army that he had six calcified nodes instead of four and, therefore, is in a position to demand compensation for life as a tuberculosis suspect?

W. Edward Chamberlain, M.D. (Philadelphia, Pa.): Four-by-ten stereoscopic roentgenograms, as made at induction stations, are remarkably satisfactory from a technical standpoint. Experience shows, however, that even when these photoroentgenograms are entirely above reproach from a technical standpoint, it is possible for the roentgenologist to overlook an important lesion. I speak from experience.

A few months ago, at the Philadelphia Induction Station, a younger colleague placed a "4 × 10" in front of me with the question: "Is that calcification at the left hilum above acceptable limits of size?" I focused my attention on the hilar calcification and expressed the opinion that it was within acceptable limits. A little later we learned that two months earlier, when this recruit had applied for a commission, he was rejected because of a reinfection type tuberculosis. On reviewing the film, we discovered a significant lesion in the right upper lobe.

A few weeks later I again missed a perfectly definite reinfection type tuberculosis in a "4 × 10" of excellent quality. The day was saved in this instance by Capt. James G. Whildin, when he reviewed the film for identification purposes. Captain Whildin then called my attention to the fact that such errors of omission can be prevented by making it a practice to view the "4 by 10's" directly, without lenses or apparatus, before or after viewing them stereoscopically. The use of the stereoscope would seem to give one "tubular vision" with increased likelihood of limiting the study to some part which attracts attention rather strongly at first glance. By looking at the film outside of the stereoscope, on an ordinary illuminator surface, one is apparently much less likely to overlook an important lesion.

I do not mean to belittle the value of the stereoscope. The point I am making is that each film should be looked at both with and without the stereoscope, if errors are to be avoided.

Co-Existence of Chronic Lymphogranuloma and Cancer[1]

DR. LEONARDO GUZMAN
Santiago, Chile

HAVING OBSERVED, in 1940, in the Institute of Radium of Santiago, Chile, two cases of cancer associated with an old benign lymphogranuloma, I undertook a survey of the literature on this problem and found that Huguier of Paris had in 1849 described what we now call Nicolas-Favre disease, with all the details and clarity of vision that distinguished the French physician from the rest of the medical world. A beautiful report on this condition was presented in 1925 by Gougerot, who gave it the name Huguier's syndrome. Gougerot did not, however, mention the possibility of cancerous change. Subsequently Chevallier, addressing the Society of Dermatology and Syphilis of Paris (1936), said: "We know of no case of cancerization of lymphogranulomatosis. We call attention to this fact because most of these patients have at the same time syphilis, and the relation that exists between syphilis and cancer is well known." Chevallier gave to the disease the names of Nicolas and Favre because of their complete clinical and pathological report appearing in 1913.

The first example of cancer arising in a lymphogranuloma which I could find was published in 1938, by Martineau and Seguin. The patient gave a history of proctitis beginning in 1904, with subsequent development of chronic ulceration and eventual appearance of cancer in 1938. Greenblatt has reported examples of lymphogranuloma undergoing malignant change and cited cases recorded by Cardwell and Pund and by Liccione, but details of these were unavailable to me. This is unfortunately true, also, of the report of David and Loring.

After my own study was completed, I found that Renato de Blasio had in 1936 presented before the Society of Dermatology and Syphilis of Paris a case of vulvar ulceration of long standing, with the development of an epithelioma in the border. This ulceration of the vulva, known as the syndrome of Clément Simon, is, I believe only the early manifestation of a lymphogranuloma, as will be shown in one of my cases, reported below. In the same year, before the same society, Gay Prieto presented a series of 850 cases of lymphogranuloma inguinale, plus 20 cases of proctitis, plus 11 cases of chronic ulceration, followed for many years without a single example of malignant change. Pardo-Castello and his associates in Mexico analyzed follow-up records of 285 patients with Nicolas-Favre disease in 1938, but discovered no instance of cancer. In the Institute of Radium of Santiago, from June 30, 1930, to June 30, 1940, 12,546 patients with cancer and allied diseases were seen, 7,318 of whom we were able to treat. Among this entire number we have found an associated lymphogranuloma only 9 times. In 8 of these cases the lesions involved the genitals or rectum and in one the floor of the mouth.

CASE REPORTS

CASE 1 (No. 5612): The patient was a woman of 30 years, evidently with ovarian dysfunction, as she gave a history of amenorrhea for three years, beginning at the age of 24, and again for four months immediately prior to admission. She had never been pregnant. In 1939 she had noticed an ulcerated area in the introitus, about 1 cm. in diameter. Though the Wassermann and Kahn reactions were negative at this time, she received neosalvarsan, but the ulceration progressed, invading the labia majora and minora and the perianal region. Operation was followed by recurrence, for which the patient was referred to our service.

The patient was pale and thin, weighing only 90 pounds. The labia were destroyed and replaced by an infiltrating papillomatous tumor, fixed to the deeper structures. Biopsy showed epithelioma with pearl formation; in some areas there were collections of pearls with little mitotic activity. The

[1] From the Instituto Nacional del Radium, Santiago, Chile. Presented before the Radiological Society of North America, at the Twenty-eighth Annual Meeting, Chicago, Ill., Nov. 30–Dec. 4, 1942.

Fig. 1. Case 1: Squamous-cell epithelioma with lymphogranuloma venereum.

stroma was not abundant and showed inflammatory infiltration, especially of lymphocytes.

A Frei reaction with human antigens was strongly positive. Treatment was begun with sulfapyridine (dagenan) and transfusions. The red cell count rose from 3 to 4 million and the hemoglobin from 55 to 85, whereupon roentgen therapy was instituted. From Aug. 19 to Nov. 14, 7,000 r were given to two fields, but treatments could be administered only irregularly on account of the poor condition of the patient. She died on Feb. 16, 1941.

At autopsy extensive ulceration and necrosis were present in the vulvar region, with perforation of the rectovaginal septum. The rectum was reduced to a narrow tube for a distance of 8 cm. from the anus. Microscopic examination showed squamous-cell carcinoma, with fibroblastic and lymphocytic reaction. Cells containing Donovan bodies were found in the deepest part. The lymph nodes showed hyperplasia but no metastatic growth. The perirectal tissue was necrotic, with areas of inflammation with pus formation.

CASE 2 (No. 5412): A woman 24 years of age was admitted to our service in May 1940. She had 2 children and six months before admission had an induced abortion. She complained of lower abdominal pain of three months' duration, aggravated by intercourse. She had lost weight until she weighed only 80 pounds.

Examination showed the clitoris to be edematous and extensively ulcerated; the labia minora were completely involved by the ulcerous process; there was some papillomatous development in the vaginal wall. The cervix was irregular, with an ulcerated area which bled easily. Examination was very painful. The body of the uterus was in good position and mobile. The left parametrium was normal but the right showed some infiltration, extending up to

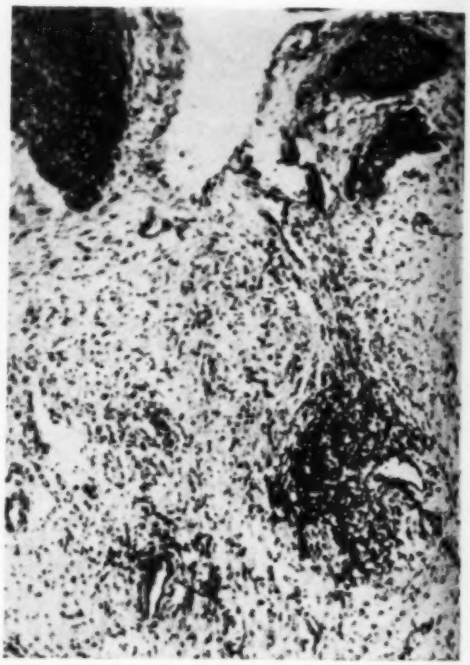

Fig. 2. Case 3: Basal-cell papillary carcinoma of cervix associated with lymphogranulomatous lesions in the fornix.

the adnexa. A biopsy specimen taken from the vulva showed thickened epithelium surrounded by edematous tissue with a somewhat loose stroma and inflammatory infiltration, especially by lymphocytes and plasma cells. The vessels were obliterated in some areas and dilated in others. The Frei reaction was strongly positive and the fundus of the eye showed features characteristic of Nicolas-Favre disease.

The cervical lesion proved to be a basal-cell carcinoma, with some keratinous activity. The stroma was scanty and, as in the vulva, showed inflammatory infiltration, especially by lymphocytes and plasma cells. The red cell count was normal.

Sulfapyridine (dagenan) was given and roentgen therapy was begun at once, supplemented by radium, 28.8 mc. being given in the vagina and an equal amount in the uterus in eight days (2,610 mg. hours in each). After two and a half months of

treatment the patient was much improved, and at the end of three months she left the hospital with both lesions apparently cured. She complained, however, of vesical tenesmus and frequency of urination, a hard mass was present in the left adnexa, and a mass of lymph nodes was palpable in the left iliac fossa.

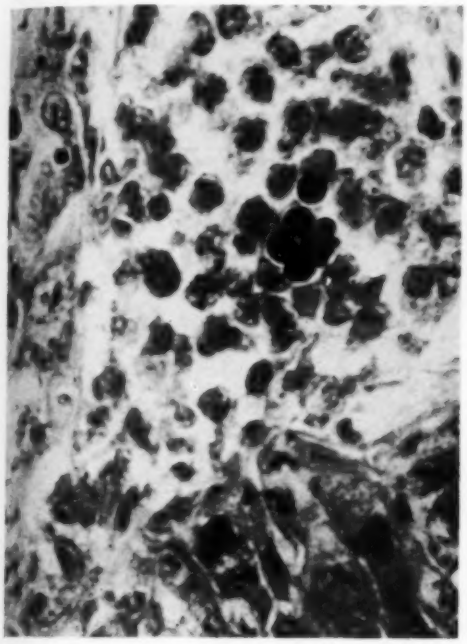

Fig. 3. Case 4: Squamous-cell carcinoma with inflammatory stroma and Donovan bodies.

The patient returned to the Institute in December 1941, cachectic and vomiting. She died in January 1942. At autopsy the diagnosis of carcinoma of the cervix and lower two-thirds of the uterus was confirmed and all the characteristic features of cancer and lymphogranulomatosis were present. No metastases were discovered. There was a coincident glomerular nephritis.

In connection with this case, I would call attention to the fact that at the Institute we employ radium for sterilizing the central part of the cancer. In this patient healing only of the ulceration of the cervix was obtained, not of the cervical canal. May it not be possible that the co-existent lymphogranulomatosis had something to do with this unfavorable result?

CASE 3 (No. 6739): A woman 44 years of age was admitted on Oct. 1, 1941. Her first menstrual

Fig. 4. Case 5: Squamous papillary epithelioma of floor of mouth associated with lymphogranuloma in the cervical lymph nodes.

period had occurred at the age of 13. She had had seven pregnancies, the last one and one-half years ago.

Five months prior to admission the patient had noticed leukorrhea and hemorrhage of traumatic origin. She had lost about 10 pounds in weight, now weighing 150 pounds. At examination the lateral right fornix was found to be infiltrated and fungating. The consistency of this infiltration was soft in contrast to a very hard infiltration of the cervix. Two biopsies were performed. The specimen from the fornix was made up of lymphocytes, plasmocytes, and small-cell tissues with all the appearance of a lymphogranuloma. The cervical specimen showed basal-cell papillary carcinoma. The Frei reaction was positive. The treatment routinely employed at the hospital for carcinoma of the cervix was given—some central radium and 3,900 r to each half of the pelvis. At the same time, as the patient was in good condition, she was given sulfapyridine. She left the hospital in February 1942 and in August of that year, when she was last seen, she had gained 12 pounds and was in good condition.

CASE 4 (No. 6784): A woman 60 years of age was admitted to the hospital on Oct. 21, 1941. Her earlier history was without significance. Three months previous to admission, she noticed an ulceration with pruritus and some burning sensation in the right labium majus. She consulted a local physician and a biopsy was taken, showing a squamous carcinoma that invaded the surrounding tissue. The stroma showed an inflammatory process, especially

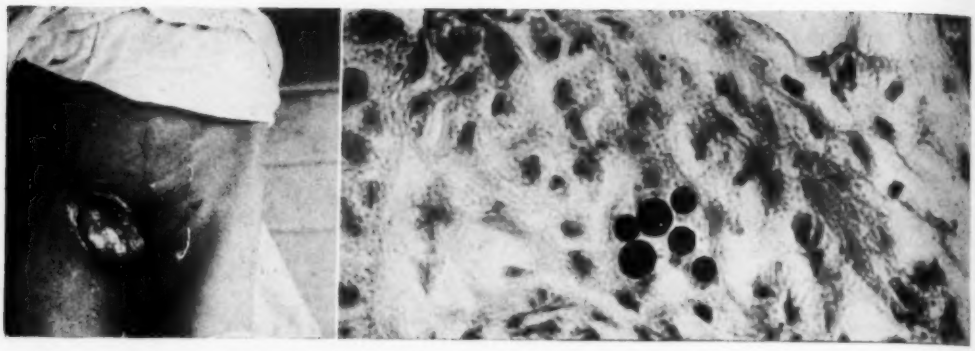

Fig. 5. Case 7: Ulcerative lesion in right inguinal region associated with a perianal tumor. Biopsy showed the inguinal lesion to be a squamous carcinoma. Donovan bodies were found in the perianal region.

about the blood vessels, with infiltration of lymphohistioplasmocytes. In view of these biopsy findings, we looked for Donovan bodies and found these, as may be seen in the illustration. The Frei and Ito reactions were both positive. Sulfa drugs were administered and a resection of the labia was done with an electrodiathermic knife. In the course of the operation it was observed that the lymphogranulomatous process in the vulva had already extended to the perirectal tissue and even the perianal muscles. Postoperative roentgen therapy was given, 5,000 r being administered. At the same time neosalvarsan and bismuth therapy was instituted, since the Wassermann and Kahn reactions were positive. When last seen, in September 1942, the patient was in good condition.

CASE 5 (No. 6785): A man 56 years of age was admitted to the hospital on Oct. 21, 1941. Six years previous to admission, he had a nervous disease, which would appear to have been a polyneuritis. He recovered after receiving some injections. Four years before admission he had noticed a small lump on the floor of the mouth, on the left side of the medial line. This lump grew slowly and was not painful. There was some hemorrhage. The patient consulted another hospital, where it was thought that he had a carcinoma of the floor of the mouth, and was then sent to us. In view of the slow development of the lesion, I thought of the possibility of lymphogranuloma and obtained a positive Frei reaction; examination of the fundus of the eyes was also positive for lymphogranuloma. Biopsy revealed a squamous papillary epithelioma with abundant mitoses; the stroma showed an infiltration of lymphocytes and plasmocytes. A sulfa preparation was given and eight radium needles were implanted in and around the lesion (for 2,904 mg. hours), giving 21.84 millicuries destroyed in seven days. A very good reaction was obtained, but a month later palpable lymph nodes in the submaxillary region and in the upper part of the parotid region were discovered. Operation was performed according to the Crile technic by a surgeon in the Institute and the lesions were found to be lymphogranuloma with Donovan bodies.

CASE 6 (No. 6842): The patient was a woman 45 years of age. She had had ten children, the last one born six years prior to admission. One year before admission, she had noticed an ulceration of the posterior part of the vulva. It had invaded to the distal portion of the posterior wall of the vagina and infiltrated the rectovaginal septum. Six months after she discovered this ulceration, she noticed that the secretion from the vagina showed traces of blood. She consulted a physician, who referred her to us. On examination, in November 1941, in addition to the ulceration already described, we found the cervix fungating and ulcerated and at the same time very hard. A biopsy specimen from the cervix showed a squamous carcinoma with considerable keratin production. A specimen from the vulva revealed the characteristic formation of lymphogranuloma, with Donovan bodies. The Frei reaction was positive. As the patient was in good condition, and the blood count was normal, we immediately gave sulfa preparations and the routine treatment for carcinoma of the cervix with radium and x-rays. She left the hospital in January 1942 and was last seen in October 1942, with infiltration of both parametria. This we attributed to the lymphogranuloma, since the Frei reaction was intensely positive, and treatment with sulfa drugs was continued.

CASE 7 (No. 7157): A woman 37 years of age was admitted to the hospital in March 1942. She had never been pregnant. Three years previous to her admission, she noticed a small lump in the perianal region, between the vulva and the anus. It was not painful and was of soft consistency. The lump had grown gradually until it was 2 inches in diameter. In 1940 the patient had entered a provincial hospital, where she was operated upon. Healing was unsatisfactory and an ulcer developed. This started to grow about six months after operation and for some time there had been a bilateral

swelling of the lymph nodes in the inguinal region. A second operation was performed in February 1942, but as the patient was getting worse, she was sent to our Institute. She was pale and thin, weighing only 70 pounds. In the right inguinal region. was a crateriform ulceration about three inches in diameter, with a sloughing appearance. There was also an ulceration in the pubic region and lymph nodes were palpable in the left groin. In the perianal region was an exophytic tumor that was hard in some parts and soft in other parts. The cervix was normal. Biopsy showed a squamous carcinoma with very loose stroma in the inguinal region. Donovan bodies were found in the tissues of the perianal region. On account of the poor condition of the patient, we gave a blood transfusion. After we had obtained some improvement, x-ray therapy was given to the inguinal region and in the pubic region—3,000 r to each—from April 3 to May 26. At the same time we gave sulfa preparations and vitamin complex. When the patient was last seen, in October 1942, she was still very thin, but the ulcerations and the tumor of the perianal region were healed.

CASE 8 (No. 6693): A woman 59 years of age was admitted to the hospital in September 1941. She had had 8 children, of whom 2 were dead. One year previous to her admission, she had a small hemorrhage and consulted a local physician who thought she had a tumor, but she did not come to the hospital at that time. She weighed 170 pounds. The vulva showed senile changes and the posterior vaginal wall was swollen and of soft consistency in its proximal two-thirds. The cervix was small, with an ulceration of the anterior half. The corpus was difficult to appreciate, because of the thickening of the vagina, but the hysterometer showed it to be 3 inches in length. Biopsy of the cervical ulceration showed papillary adenocarcinoma. We also performed a vaginal biopsy and found the characteristic appearance of a lymphogranuloma. Treatment was by sulfa preparations and radium and x-rays. When the patient was last seen, in August 1942, she had rectal tenesmus with blood in the stools and evidence of a beginning stricture, but the lesion of the cervix and of the vagina had disappeared. Continuation of sulfa therapy was advised.

In this case occurred a very curious thing to which I shall call attention because of its teaching value—namely, that only the fourth biopsy of the cervix led to the diagnosis of carcinoma. I had insisted on the biopsy because I noticed a very hard region in the cervix that could not be explained by lymphogranuloma alone.

CASE 9 (No. 7125): A woman, 40 years of age, had in 1926 been seen in the Gynecological Clinic with squamous epithelioma of the cervix. She received some radium for five days and also some x-ray therapy. Four years later (1930) she had a gonorrheal infection, with endometritis and cystitis, that was cured in about two months. Seven years after this (1937) she had appendicitis and it was then found that both labia majora were edematous and that at the base of the clitoris there was ulceration without induration. The diagnosis was lymphogranuloma, and the Frei reaction and Ito reaction were both positive. Folliculin was prescribed and the edema of the labia was thought to have diminished. In 1940 the patient again went to the Gynecological Clinic, where a diathermocoagulation was performed. The specimen was examined and an early squamous epithelioma in the vulva was discovered. The patient disappeared and was not seen in our service until December 1941. At that time her condition was poor. In the hypogastric region was a large ulceration extending through the pubic region and the vulva down to the anus. The ulceration was thick and indurated. Abdominal examination showed numerous painful masses in the pelvis, of different sizes. Biopsies of the hypogastric and perianal regions showed lymphogranuloma and squamous-cell carcinoma.

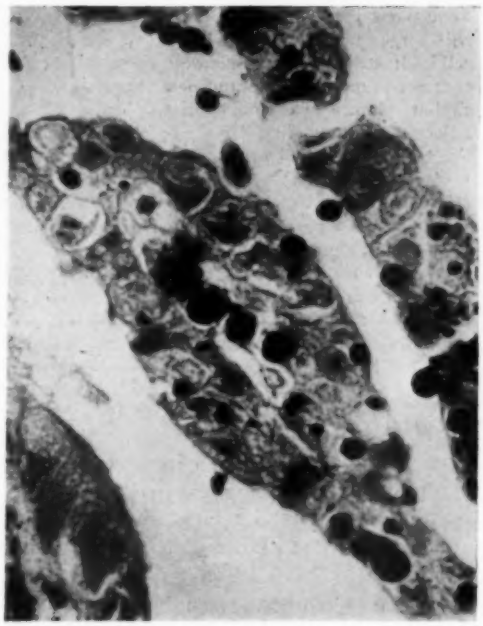

Fig. 6. Case 8: Papillary adenocarcinoma of cervix with vaginal lymphogranuloma.

Because of the patient's extreme cachexia, nothing could be done and she died in April 1942. In addition to the ulceration already described, lymph node metastases were present in the lumbar and pelvic regions. Pathological study of the vulvar tissue showed squamous prickle-cell epithelioma, in

some parts papillomatous. The stroma was loose, with large lymphocytes and plasmocytes and small-cell infiltration. The vessels were surrounded by an enormous amount of old and new fibrous tissue. A similar picture was found in the cellular tissue adjacent to the vagina. In the bladder were a considerable fibrous infiltration and numerous telangiectases, due perhaps to the radium treatments received fifteen years previously. The cervix and body of the uterus were composed of fibrous tissue but without signs of carcinoma. The lymph nodes of the pelvis were completely transformed into a purulent mass. The lumbo-aortic nodes showed hyperplastic adenitis. We also discovered some lymph nodes in the gastrocolic omentum and there we found Donovan bodies, as in the vulva.

This case is of special interest, since the patient had had an earlier carcinoma, and then venereal disease of various types, then lymphogranuloma, and eventually a second carcinoma. This latter was not a recurrence of the first cancer but an independent lesion grafted on diseased tissue in a woman who had a tendency to cancer formation. I would explain this last assertion on the theory that to produce a cancer cell it is necessary to have the coincidence of a general and a local factor.

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Venography with Fluoroscopy in Venous Lesions of the Lower Limb[1]

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MANY ASPECTS of venography have been discussed in the literature and several technics have been offered. The present paper will describe our combined fluoroscopic and radiographic technic and discuss the indications, interpretation, and applications of the method in the diagnosis and treatment of varicosities, thrombosis, and thrombo-embolic phenomena.

The first roentgenologists successfully to demonstrate veins in living human subjects by the direct injection of a radiopaque medium were Berberich and Hirsch (5), who in 1923 used strontium iodide. In 1929 McPheeters and Rice (9) studied the direction of flow in varicose veins under the fluoroscope, using droplets of lipiodol but not in sufficient quantity to outline the venous channels. It was not until reagents were discovered for intravenous urography that media were available which could be used in sufficient quantity to permit adequate filling and demonstration of veins.

Ratschow (12) in 1930 used first uroselectan and then iopax, obtaining successful venograms by direct injection. Sgalitzer, Kollert, and Demel (16) demonstrated varicosities by direct injection in 1931. In 1932 Barber and Orley (2) effectively summarized the essential phenomena of venous flow as evidenced by fluoroscopic study. They reached the following conclusions: (1) The normal internal saphenous vein shows a slight dilatation at the level of the internal condyle of the tibia corresponding to a constant valve in this situation. In varicose veins a large ampullary dilatation is occasionally seen at this site. (2) In the normal limb the direction of flow is toward the heart. Backflow is stopped by the first valve below the site of injection. In varicose veins the flow is in both directions, the backward flow being due to incompetent valves. (3) Normally none of the solution passes from the deep to the superficial veins. In some cases of varicose veins the solution does pass from the deep to the superficial vessels by way of anastomotic channels but never by the venae comites. (4) The rate of flow is affected by posture, state of rest or muscular activity, and respiration. (5) Radiography of veins may be of considerable assistance in evaluating cases of varicose veins not responding to injection therapy.

Pomeranz and Tunick (11) published similar results of roentgenoscopic and radiographic studies. They clearly demonstrated the normal anatomy and the anatomical abnormalities present in varicose veins, emphasizing the tortuosity, dilatation, pooling, and reduction in number of valves in varicosities, as well as luminal irregularities in the presence of phlebitis.

The first to report the successful use of diodrast were Edwards and Biguria (7) in 1934. Veal and McFetridge (18) in 1935 were apparently the earliest authors to describe the value of venography in obstructive lesions of the upper limb. Using thorium dioxide they observed the appearance of such lesions and studied the emptying time of the veins fluoroscopically. Occlusive lesions of the lower limb were described a year later by Barker and Camp (3), who demonstrated a variety of pathological conditions. There was, however, no confirmation, operative or otherwise. Dos Santos (13, 14, 15) carried out similar investigations. Bauer (4) in 1940 correlated venographic findings with thromboembolic phenomena. Dougherty and Homans (6) in a study of 15 cases were able

[1] From the Metropolitan Hospital, New York City, Department of Surgery, Dr. L. R. Kaufman, Director; and Department of Roentgenology, Dr. T. B. Weinberg, Director. Accepted for publication in February 1943.

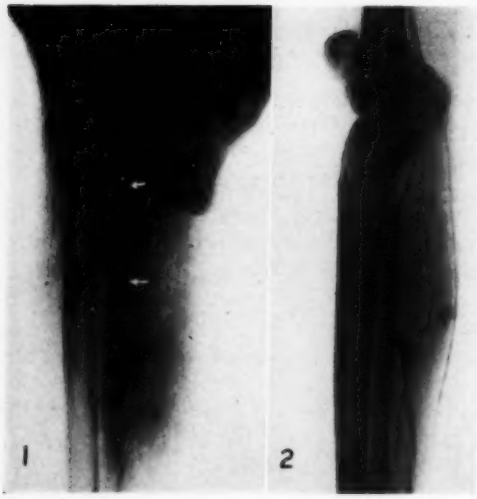

Fig. 1. A normal venogram of the thigh showing tubular femoral vein with few collaterals. Arrows point to valves.

Fig. 2. Spasm of the popliteal vein gradually tapering in both directions. This vessel was well filled during fluoroscopy.

to demonstrate deep thrombophlebitis in 9 cases, with operative confirmation of 2. Starr, Frank, and Fine (17) recently reported 4 cases, of which 3 were confirmed by operation.

TECHNIC

After experimental trial of various procedures utilized by Dougherty and Homans, Bauer, Starr, and others, we developed the following technic. The patient is placed prone on the fluoroscopic table with the foot everted and the limb slightly abducted. Under local anesthesia a vertical incision 1.5 cm. in length is made about 1.0 cm. posterior to the external malleolus. At this point a tributary of the short saphenous vein is readily isolated. A No. 19 transfusion cannula is tied into the vein. To this is attached a Luer-Lok syringe containing 30 c.c. of 35 per cent diodrast solution. Injection of the opaque medium is then begun under fluoroscopic visualization and continued while the course and progress of the solution are observed throughout the length of the extremity. This requires no more than 10 to 15 c.c. injected over a period of from ten to thirty seconds, depending on the rate of circulation in the limb. Fluoroscopy is then discontinued, and a similar amount is injected over the same time interval, at the end of which x-ray films are made.

After the major pathological lesion has been identified and localized fluoroscopically, the patient is positioned so as best to demonstrate the area involved. When the lesion is located in the lower leg, he lies supine and the exposure is made with the leg in the anterior-posterior position with the foot slightly inverted. When the lesion is in the thigh, films taken with the patient in the prone position, with the foot everted and the limb slightly abducted, are most informative. This position also is adequate for demonstration of venous structures in the pelvic region. Moreover, if one desires a picture of the venous system of the limb in continuity, it may be taken in this position either on a film 34 inches long or by overlapping two 14 × 17-inch films, as was done in most of our cases.

A spot film device would have been useful for demonstration of localized areas. However, none was available for our studies.

The roentgenological factors, briefly summarized, are:

1. For a full limb: 90 kv., 50-inch distance, 100 ma., 1/10 second. When two films are overlapped, one should either use a slow screen for the lower leg or insert a piece of black paper into the lower cassette to avoid over-exposure.

2. For the leg from the knee down: 55 kv., 40-inch distance, 100 ma., 1/10 second.

3. For knee to pelvis (non-Bucky): 65 kv., 40-inch distance, 100 ma., 1/10 second.

4. In a heavier patient, if one desires more detail, the Bucky may be used for the thigh and pelvis. The factors then would be 78 kv., 36-inch distance, 50 ma., 1 second.

The combined fluoroscopic and radiographic technic has many advantages over radiography alone. The value of fluoroscopy in venography may be likened to its importance in gastro-intestinal examina-

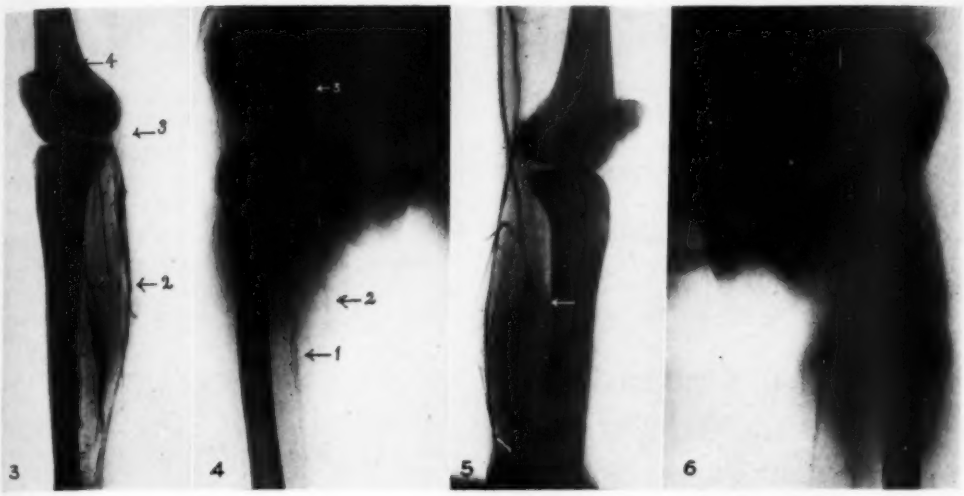

Fig. 3. Case I: Normal leg showing (1) valve on branch of posterior tibial; (2) two short saphenous branches; (3) communicating channel to long saphenous; (4) popliteal vein formed by fusion of anterior and posterior tibial with the short saphenous.

Fig. 4. Case I: Normal right thigh showing (1) straight tubular femoral vein; (2) long saphenous vein; (3) external iliac vein.

Fig. 5. Case I: Pathological left leg showing blind end of posterior tibial tributary of the popliteal vein, with complete absence of popliteal at the knee and femoral vein in the thigh. Extensive collateralization is present.

Fig. 6. Case I: Thigh and pelvis of affected side showing absence of entire femoral and iliac veins with extensive collateralization and reflux filling of all of the tributaries of the long saphenous radiating from the region of the fossa ovalis.

tion, in that it gives the dynamic picture of a functioning organ in addition to the static impression obtained during a momentary exposure. Secondly, as previously mentioned, the area involved having been localized, the x-ray may be so centered as to give the clearest possible picture of the structures. Furthermore, the quantity of dye necessary to outline the venous channels clearly can be determined, as well as the time interval required for optimum filling.

NORMAL

Normal filling of the venous channels of the lower limb is illustrated in Figures 1, 2, 3, and 4. The important features are as follows.

(1) The deep tributaries of the lower leg fuse to form the venae comites of the anterior and posterior tibial arteries, which in turn fuse with the short saphenous in the popliteal region forming the popliteal vein (Fig. 3).

(2) There is straight tubular filling of the popliteal and femoral veins, the latter becoming, in the inguinal region, the straight tubular iliac vein (Fig. 4).

(3) A communication often exists between the deep and superficial veins in the popliteal region, resulting in filling of the long saphenous vein (Figs. 3 and 4).

(4) At varying levels in the course of the veins valves may be seen. If these are partially open, one sees two fine lines converging toward the center of the vein. External to these lines symmetrical bulges in the vein walls represent the paravalvular sinuses (Fig. 1).

(5) Spasm may be present, characterized by smooth tapered narrowing proximal and distal to an area of complete or almost complete occlusion (Fig. 2). Since this is momentary, fluoroscopy and the absence of abnormal collaterals help one to recognize this phenomenon.

PATHOLOGICAL CONDITIONS

Superficial occlusion may involve the entire long saphenous vein or may be con-

fined to a segment of the vein, as evidenced by absence of filling of the affected area, this segment being bridged by collaterals. This is best illustrated by direct injection into the long saphenous.

Varicose veins, as illustrated in Figures 9, 10, and 11, show extensive increase in the number of veins, which are dilated and tortuous, with numerous kinks, pooling, and a diminution or even a total absence of valves.

Occlusion of the deep veins of the lower leg is indicated by complete absence of filling, as shown in Figure 11, or abrupt stoppage of the dye, as in Figure 5, associated with extensive collateralization bridging the occluded area. This picture is encountered in a fair proportion of patients with varicose veins, the superficial varicosities representing large, dilated, and tortuous collateral channels (Fig. 11).

Complete occlusion of the femoral veins, such as occurs in deep thrombophlebitis, is indicated by absence of filling of the main venous channels (Figs. 6 and 11), together with extensive, divergent, and tortuous collateral channels. If the process extends above the sapheno-femoral junction into the external iliac, the tributaries of the long saphenous in the upper part of the thigh and pubic region are filled and dilated, with complete absence of visualization of the external iliac (Fig. 6).

Incomplete and more localized occlusion of the main channel (Fig. 8) shows narrowing of the lumen with irregularities and plaque-like deposits in the intima as well as localized dispersal of diodrast into clusters of tributaries, together with prominent dilatation at the site of valves.

The following case reports are presented to illustrate several types of venous pathology as demonstrated venographically and correlated with clinical and operative findings.

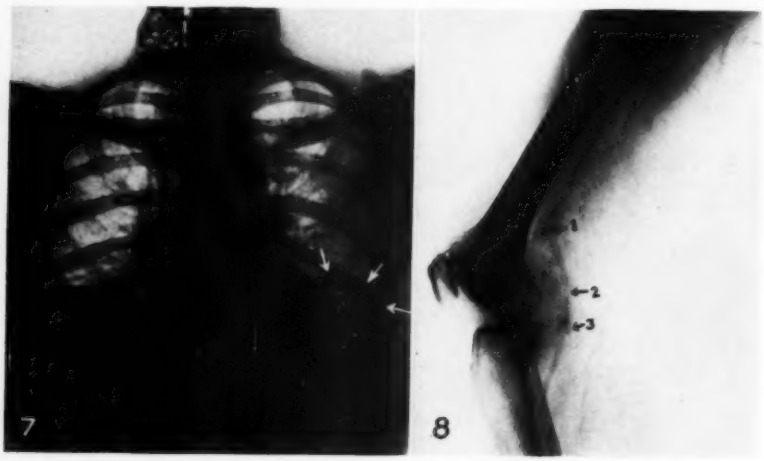

Fig. 7. Case II: Chest film showing zone of involvement at left base, with effusion in costophrenic sinus.

Fig. 8. Case II: Arrows 1 and 2 point to luminal irregularities in the vein; arrow 3 to dilated popliteal valve. Collateralization is present in region of knee and thigh.

CASE I: I. L., 22-year-old white female, was admitted on April 8, 1942, complaining of pain in the groin and swelling of the left leg of ten days' duration. Sixteen days prior to the onset of her symptoms she had an apparently normal parturition.

Physical examination at the time of admission showed the following significant findings: temperature 101°; uniform swelling of the left lower limb, with pitting on pressure; tenderness over the fossa ovalis and tender adenitis in the left inguinal region, as well as tenderness to deep palpation in the lower left quadrant. Despite an apparently normal white cell count and differential count, there was a significantly rapid sedimentation rate of 84 mm. in one hour.

The patient was observed and treated conservatively for about three weeks, after which venography of both lower extremities was performed. The right lower limb showed normal filling of the deep veins (Figs. 3 and 4). The left limb, on the other hand, showed complete occlusion of the deep veins from below the popliteal through the iliacs (Figs. 5 and 6).

Venographic and clinical findings were substantiated at operation, at which time the femoral vein in the groin was found to be solidly thrombosed, the thrombosis extending into the external iliac. The patient made an uneventful recovery and was discharged on May 20, 1942.

CASE II: H. J., 75-year-old colored female, was admitted on June 25, 1942, complaining of cough productive of large amounts of foul blood-streaked sputum, fever, and chills, and a loss of 30 pounds during the previous two months. Two weeks prior to admission she began to experience pain and discharge from the right ear and painful swelling of the left knee.

Physical examination revealed dullness, diminished breath sounds, and moist râles at the left base, with bronchophony in the left hilar region. The left knee was swollen and tender, with severe pain on motion. The left thigh was somewhat warmer than the right. The white cell count was 15,000 with a shift to the left; the sedimentation rate was 32 mm. in one hour.

X-ray examination of the chest revealed a zone of increased density at the left base and obliteration of the left costophrenic sinus (Fig. 7). The diagnosis was left pleural effusion with underlying abscess, infarct, or neoplasm.

Because of suspicion of a septic infarct resulting from thrombophlebitis, venography was performed on July 18 (Fig. 8). The lumen of the popliteal and femoral vein appeared irregular, and constant plaques were present in the walls. The valve in the popliteal region was prominent and local collateralization was present. On the basis of these findings femoral vein ligation was done just below the inguinal ligament, at which site the vein was patent and apparently normal. At the lower end of the dissected area, however, 6 cm. distal to the site of ligation, an organized plaque was palpated within the lumen of the vein.

Subsequent to operation the patient's general health improved. Her pulmonary symptoms subsided, she gained weight and was well enough to be discharged on August 25. At the time of discharge x-ray showed resolution of the infarct at the left base with some residual pleural thickening.

CASE III: O. W., a 56-year-old white male, had sustained a fracture of his right leg in January 1942. In April 1942, after removal of a cast, the leg was swollen from the toes to the knee. This swelling subsided with bed rest. It recurred, however, when the patient again became active. Thrombophlebitis was suspected and venography was done on May 9, 1942, showing normal filling of the veins of the extremity with no evidence of any occlusive lesion. Thrombophlebitis having been ruled out, the orthopedist proceeded with treatment.

Fig. 9. Case IV: Normal femoral and long saphenous. Arrow points to dilated tortuous communicating veins as contrasted with those in thigh. Note extensive varicosities in calf and popliteal region.

CASE IV: J. L., a 42-year-old white male, was referred to our peripheral vascular clinic on April 20, 1942, with a history of varicose veins and a painful ulcer over the anterior medial aspect of the right leg which had healed and recurred intermittently over a period of twelve years. He had sustained a compound fracture of the same leg fifteen years previously, to which he attributed his difficulties.

Examination showed a dirty grayish ulceration about 6 × 8 cm. over the antero-mesial aspect of the right leg and prominent superficial varicosities of the lower leg, particularly in the popliteal region. The usual clinical tests for varicose veins indicated competent sapheno-femoral and saphenous valves in the thigh but were confusing and inconclusive as to the possibility of disease of the deep veins.

Venography on April 25 showed normal filling of the deep veins with prominent superficial varicosities involving a large communicating vein in the popliteal area (Fig. 9). In view of this confirmation of normal deep veins, operation was performed to ligate the superficial varicosities and incompetent communicating vein in the popliteal region. Within one week after operation the patient experienced a marked relief of pain in the affected leg and there was evidence of healing in the ulcerated area. One month after operation healing was complete and there had been no recurrence in five months.

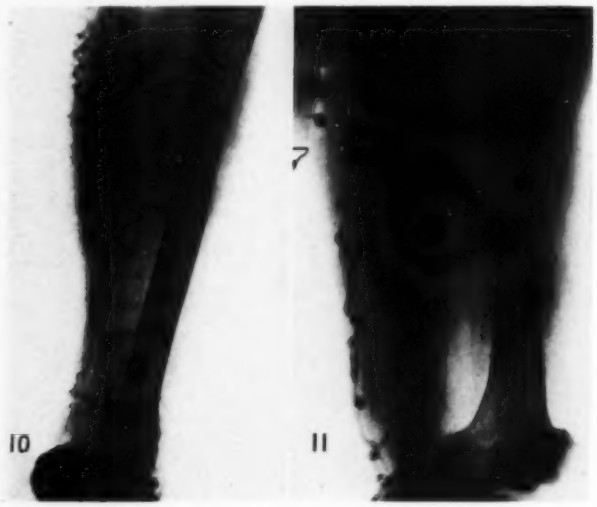

Fig. 10. Case V: Elongated, dilated, and markedly tortuous long saphenous vein with many tributaries. Note complete absence of femoral vein.

Fig. 11. Case V: Numerous tortuous varicosities with absence of deep vessels beyond the middle of the calf.

CASE V: M. M., a 60-year-old white female, appeared at our clinic with a history of recurrent ulceration about the right internal malleolus for the past twenty years, with associated prominent varicosities of the leg. All clinical tests indicated deep vein obstruction or incompetency as the etiological factor. Venography, performed June 20, 1942 (Figs. 10 and 11), showed absence of filling of the entire deep venous system of the extremity with marked compensatory dilatation and tortuosity of the entire superficial saphenous system. In view of this corroboration of extensive disease in the deep veins, surgical or sclerosing therapy of the superficial saphenous system was contraindicated.

COMMENT

Deep thrombophlebitis does not always present the clear-cut clinical picture so frequently described in the textbooks. Furthermore, thrombo-embolic pulmonary accidents may occur from a peripheral deep vein thrombosis in the absence of well defined clinical features pointing to the source of the embolus. It is well demonstrated in Case II that an unexplained spontaneous pulmonary lesion may be thrombo-embolic in origin, warranting the accurate demonstration of the presence or absence of a peripheral thrombophlebitis. Such accurate information can be readily obtained by venography of the lower extremity. In the presence of a clinical history suggesting deep vein thrombophlebitis, even though physical findings have completely subsided, venography should be undertaken. The prophylactic value of ligation proximal to such a thrombophlebitic process is obvious.

The problem of varicose veins lends itself readily to venographic investigation. The clinical tests ordinarily employed to evaluate the status of the deep veins are often inconclusive. Since it is upon this status that the indications for surgical ligation and sclerosing therapy are dependent, venography is of use in evaluating

cases which have not responded to therapy. In some instances an incompetent communicating vein is present which, through retrograde flow, keeps the varicosities patent. In others collateralization around the ligated and resected segment causes the failure to respond. After these abnormal vessels are located by venography, their ligation may result in cure of the varicosities.

In none of our 25 cases were there any severe effects. No thrombi were dislodged, nor did phlebitis occur at the site of injection in any patient. One man showed a sensitivity to diodrast manifested by a marked urticaria. This was relieved by the administration of adrenalin. These findings are consistent with those of other workers.

SUMMARY

1. The literature of venography has been reviewed.

2. A combined fluoroscopic and radiographic technic has been described.

3. The interpretation of normal and pathological venograms has been discussed.

4. Five cases of various types have been presented, with illustrative venograms.

5. The clinical aspects of venography have been evaluated.

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Selection of Physical Factors for Maximum Output in Roentgen Therapy[1]

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IF, WHEN A radiologist decided to treat a deep-seated lesion in a thick patient, he could select a very high-voltage generator with good output and could make use of multiple large skin portals with long anode-skin distance and heavy filtration, he could deliver into the lesion a dose more than the surrounding normal tissues could tolerate without permanent injury. The satisfactory treatment of such tumors is, therefore, not limited by physical factors.

Limitations of time and equipment, however, tend to restrict the choice of treatment conditions for the great majority of radiologists, so that optimal depth doses are not usually obtained except in the more favorable cases. Very high-voltage generators are expensive, and only a few are in use. Most radiologists have available 200-kv. outfits of moderate output, with which heavy filters or long anode-skin distances cannot be used without reducing the dose rate to impracticably low values. Large skin portals greatly increase the percentage depth dose with such generators but limit the number of portals which can be arranged without overlap, limit the daily dose by increasing the volume of tissue irradiated and thus the toxic reaction, and, to a certain extent, limit the total dose to the skin which can be given without permanent injury. On the other hand, the use of many small ports introduces difficulties in centering, makes it hard to avoid overlapping of entrance and exit fields, and increases the time and attention required of the radiologist.

Since the choice of field size is rather closely limited by considerations other than attaining maximum dose rate, the radiologist who has only a relatively low-voltage generator must use long anode-skin distances and heavy filtration to achieve the necessary high percentage depth doses for satisfactory treatment of deep-seated lesions. He will discover that a relatively small gain in percentage depth dose requires a large reduction in dosage rate, so that he soon finds his treatment times impracticably long. The lowest dosage rate which he is willing to tolerate sets the limit to his percentage depth dose and so to the maximum depth at which a lesion can be irradiated to the limit of tolerance of the surrounding tissues, assuming that his generator is used to the best advantage.

It is the purpose of this paper to show that there is an optimum relation between filtration and anode-skin distance for a particular generator which gives maximum tumor dose rate. This combination of filtration and anode-skin distance is independent of field size and percentage depth dose. It will be shown that, when properly selected, a single filter can be used efficiently for all cases where maximum depth dose is of importance. A set of curves may be drawn from which the optimum constants for most treatment problems may be selected.

If one measures the output of his generator with the usual aluminum filter, limiting diaphragms, and cones in place, and calculates the half-value layers corresponding to a suitable range of added filtration, he can investigate the effect of changing filter and distance by calculating the skin dose obtained as the added filter is increased, a selected value of percentage depth dose being maintained by varying the anode-skin distance in proportion. Combinations of field size and percentage depth dose are chosen to cover the whole

[1] From the Department of Radiology, San Francisco Hospital, and the Department of Medicine, Stanford University Medical School. Accepted for publication in February 1943.

useful range of intensities. When these curves are plotted to show skin dose rate as a function of filtration, one finds that the maximum skin dose rate for each combination of field size and selected percentage depth dose lies close to a single curve, which then represents the optimum added filter as related to skin dose rate. If the depth dose at 10 cm. depth and field size were chosen by trial to give spaced curves throughout the expected useful range of intensities. Quimby's depth dose tables (1) were used to obtain the percentage 10-cm. depth dose for each field size over the range of half-value layers corresponding to the appropriate filters. From these

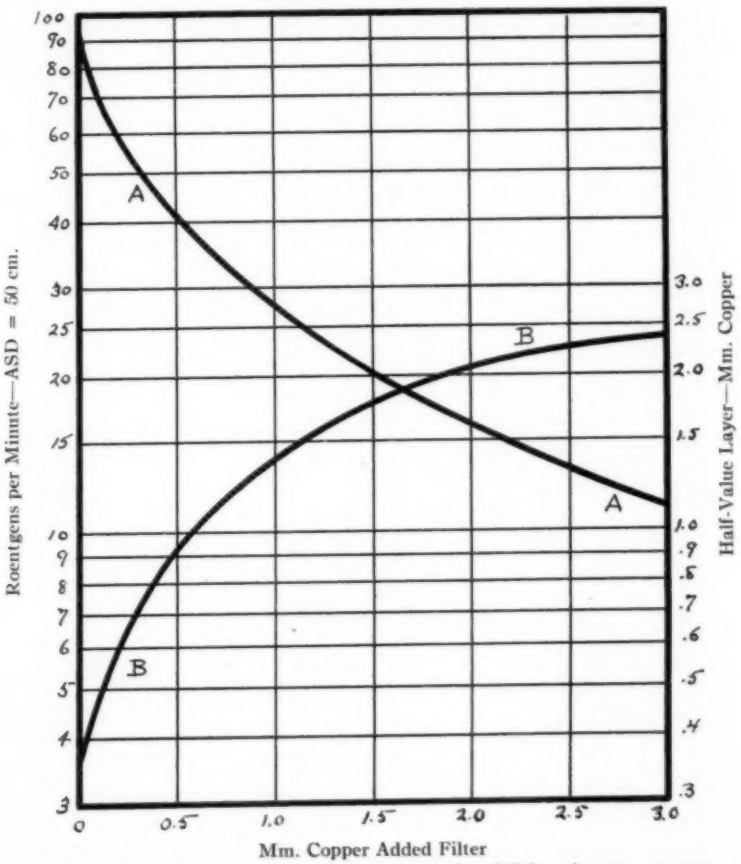

Fig. 1. Output characteristics of a representative 200-kv. therapy generator. A. Output: roentgens per minute at 50 cm., 200 kv., 20 ma. B. Half-value layer in mm. copper.

corresponding distances are plotted, one obtains the curve relating distance to filtration.

Figure 1 shows the output characteristic and the calculated half-value layer curve for a representative 200-kv. x-ray generator. The curves of Figure 2 were calculated as follows. Pairs of values for percentage depth-dose values at a standard distance and tables of the effect of distance on depth dose, one can calculate the distance at which the selected values of depth dose are obtained. Back-scatter tables are then consulted for the ratio of skin dose to air dose for the different field sizes. Having this, the output of the generator at a stand-

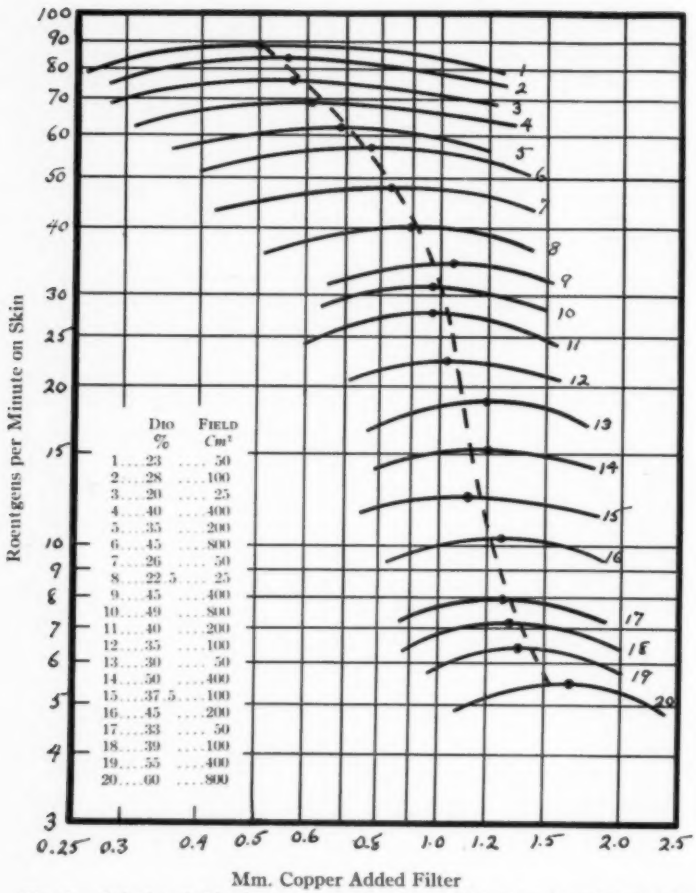

Fig. 2. Calculated skin dose rate as a function of filtration for selected field areas, the 10-cm. depth dose being held constant for each curve by varying the anode-skin distance. The dotted curve gives the optimum relation. The curves cover the range within which the skin dose rate is over 90 per cent of maximum.

ard distance, and the distances calculated to give the selected depth doses, one can readily calculate the skin dose under the required conditions. Each of the curves of Figure 2, then, represents the skin dose, which is proportional to tumor dose, obtained as the filter is varied, the anode-skin distance being adjusted to give a constant depth dose. Many similar curves can be calculated for other pairs of depth doses and field sizes. In Figure 2 the maxima have been marked and a curve drawn through them by inspection. This curve gives the maximum skin dose rate which can be obtained by adjusting the distance and filtration to achieve a selected percentage depth dose using a selected field size.

From the same data, the curves of Figure 3 were plotted to show the relation of anode-skin distance to filtration, individual curves corresponding to the same depth-dose field size pairs as in Figure 2. One can plot the maxima of Figure 2 on the curves of Figure 3 and draw the curve showing the relation of distance to filtration to give maximum skin dose rate for selected values of field size and percentage depth dose.

Packard (2) has shown that if the percentage depth doses attained at a given

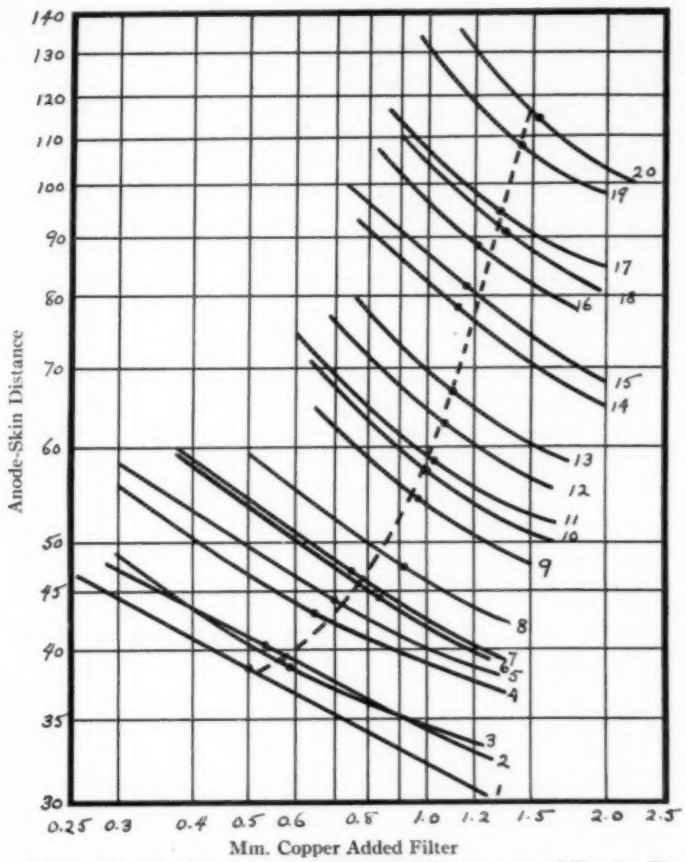

Fig. 3. Distance-filtration relation corresponding to curves of Fig. 2. The dotted curve gives the optimum relation. The curves cover the range within which the skin dose is over 90 per cent of maximum.

depth by different combinations of technical factors are equal, then the doses at other depths below 2–3 cm. are also equal. Therefore, the calculations and conclusions given above apply unchanged if the percentage depth dose at 10 cm. depth is corrected by Packard's ratios for the depth in question. Although the optimum values as predicted by curves like Figure 3 give the maximum dose rate for any therapeutic condition in which skin dose limits the tumor dose, the actual time saving is not appreciable unless the dose rate approaches the lowest practicable value. That is: a 20 per cent saving on a two-minute treatment time is not appreciable, but 20 per cent on a sixty-minute treatment is worth while.

On inspection of Figure 3, one notes that the very desirable simplification of using a single filter for all cases where maximum depth dose is important is possible with nearly maximum output if one chooses 1.25 mm. of copper added. This value is the calculated optimum at about 80 cm. anode-skin distance, where the output is 12 r/minute on the skin, a suitable set of factors for many therapy requirements. When large fields and long distances are used to attain higher depth doses, the output would still be about 94 per cent of the maximum calculated. If shorter distances and smaller fields are to be used, 90 per cent of the maximum rate can be attained. For example: 1.25 mm. Cu added filter at 30 cm. anode-skin dis-

tance, with a field of 50 sq. cm. gives a 23 per cent 10 cm. depth dose with a skin dose rate of 79 r/minute. The optimum calculated factors were 0.5 mm. Cu added, 38 cm. anode-skin distance, giving the same percentage depth dose with a skin dose rate of 88 r/minute.

Thus, this filter could be used efficiently over the whole range of treatment conditions considered except that the limited cone of rays sets the minimum distance at which a given field can be covered. It would be desirable, then, to have a second, thinner filter to cover large fields at a higher rate when low percentage depth doses can be tolerated. By inspection, a filter of 0.5 mm. Cu would be suitable for use up to 57 cm. anode-skin distance, where it would give the same output, and depth dose, as the 1.25 mm. filter at 43 cm. One would therefore recommend these two filters for use with this particular generator under the conditions specified. It should be carefully noted that these specific recommendations apply only to a generator with an output characteristic similar to that given in Figure 1. The optimum relations are, in fact, quite sensitive to change in output characteristic.

Having chosen a filter of 1.25 mm. Cu for "deep therapy" cases, one can draw a set of curves such as Figure 4, showing the performance of the generator with a wide range of technical factors. For each of a selection of field sizes, a curve is drawn to show the relation of anode-skin distance to percentage 10-cm. depth dose. Furthermore, one can calculate the skin dose rate for a number of points from the known air dose rates, allowing for back-scatter appropriate to each field size, and draw isodose curves to complete the family of Figure 4.

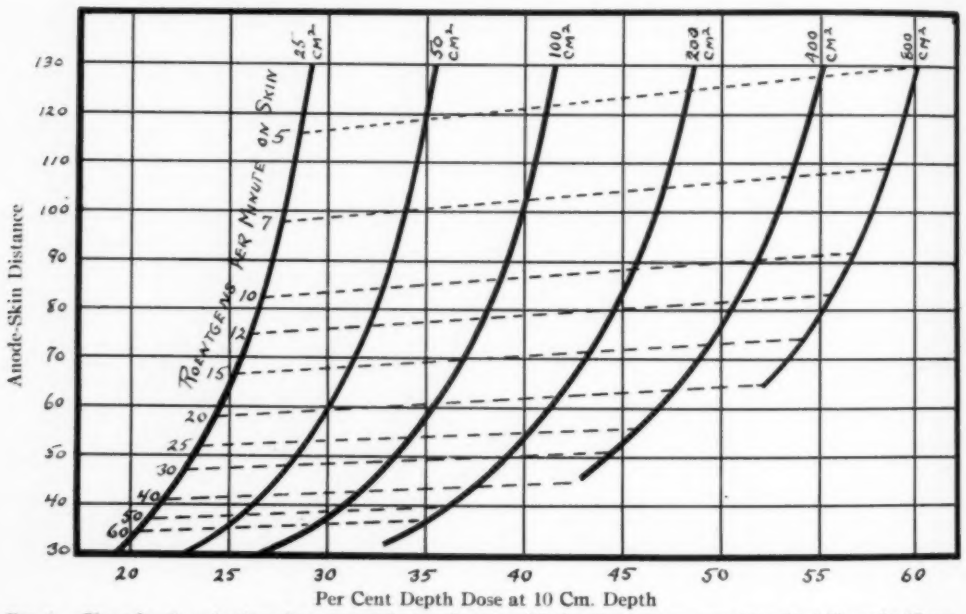

Fig. 4. Chart for the selection of treatment factors for use with the given generator with added filter of 1.25 mm. copper.

The utility of these curves is best shown by examples. If the radiologist chose a 200-sq. cm. field and wished to obtain 45 per cent depth dose at 10 cm., he should use 83 cm. anode-skin distance, which would give a skin dose rate of 11 r/minute; that is, a tumor dose rate of 4.95 r/minute. If he wished a 50 per cent depth dose, he would find it impossible to attain, within

range of the chart, unless he increased the field size. An increase of field size to about 350 sq. cm. (interpolating between the curves) would give the same dose rate at about 85 cm. distance and increase the depth dose to the required 50 per cent. If he decided that 10 skin r/minute was the lowest dose rate he could tolerate and wished to maintain a 50 per cent depth dose, he would need a field of at least 330 sq. cm. If he were willing to go to 5 skin r/minute, he could cut his field to about 250 sq. cm.

One notes clearly from these curves the relatively great increase of depth dose with field size and rather moderate but appreciable increase with distance. Furthermore, this latter is attained only at great cost in dose rate.

SUMMARY

Radiologists who have only medium-voltage therapy generators must use them efficiently if they are to attain satisfactory percentage depth doses with practicable dose rates. A method for calculating the optimum relation between anode-skin distance and added filtration to obtain maximum tumor dose rates has been demonstrated. Specific curves for a typical medium-voltage generator have been presented.

CONCLUSIONS

1. For a particular generator, there is a fixed relation between anode-skin distance and added filtration which gives a maximum tumor dose rate with a given percentage depth dose, this relation being independent of field size.

2. It is possible to select a single filter (1.25 mm. Cu for our generator) which allows nearly maximal dose rates in all cases where maximum depth dose is desired. Percentage depth dose and dose rates are then controlled by anode-skin distance. A thinner filter (say, 0.5 mm. Cu) is needed to cover large fields at low percentage depth doses.

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[Depth doses were interpolated along a smooth curve on semi-logarithmic co-ordinates drawn through Quimby's values for 10 cm. depth, 100-sq. cm. field size, 50 cm. anode-skin distance, at several half-value layers. It was necessary to extrapolate the curve moderately to 2.5 mm. Cu.

The effect of anode-skin distance on depth dose was plotted from Quimby's inverse square relation. Backscatter values for large fields and high half-value layers were taken from extrapolated curves drawn from Quimby's tables.

The change of depth dose with field size was taken from Packard (see below), again extrapolated to the largest field size along a smooth curve.]

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Roentgen Examination of Pancreatic Tumors[1]

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IF WE EXAMINE the textbooks dealing with diseases of the abdominal organs, we find that the chapters presenting the x-ray findings in pancreatic tumors are usually brief as compared with those concerning other abdominal viscera. In addition most of the opinions as to the value of roentgen examination in these tumors show a degree of skepticism which stands out in sharp contrast to the confidence expressed in x-ray studies of abdominal neoplasms of other origin.

The explanation of this attitude is found in the fact that the pancreas, in contrast to other abdominal viscera, cannot be visualized directly with the aid of opaque media, whether administered perorally or parenterally. Thus the *normal* pancreas cannot be portrayed on the x-ray film. This failure of direct visualization, however, presents no handicap to diagnosis of certain tumors of other origin. Tumors arising from the hypophysis, for example, can be diagnosed roentgenologically despite the fact that the normal organ cannot be shown on the film. The reason for this situation is that the hypophysis exhibits tumor growth by enlargement, with consequent displacement or destruction of the neighboring sella turcica. Similarly the thyroid gland gives evidence of tumor growth, roentgenologically, by displacement or compression of the trachea. The same principle applies to tumors arising in the pancreas.

The difficulty in the case of pancreatic tumors results, in the final analysis, from the fact that, being of considerable length (15–20 cm), the pancreas has in close proximity *not a single organ but a number of organs* or structures, as the stomach, duodenum, colon, common duct, spleen, kidneys, spine, diaphragm, and solar plexus (Fig. 1). Since it is not the growth itself but the structures compressed or invaded by it which give rise to the symptoms, the signs vary with the site of the tumor. Tumors localized in the head, body, and tail of the pancreas produce symptoms as different from one another as if they were produced by tumors of different organs. This variety of symptoms is augmented by the tendency of the tumors to affect the different portions of the pancreas in succession.

The variety of symptoms necessitates a variety of methods for their detection. As a consequence, in no other organ are so many methods of examination required as in the x-ray study of pancreatic tumors. It is safe to say that the failure to diagnose a pancreatic tumor roentgenologically is in most cases the result of not having made use of all the methods available. With the use of all such methods, the roentgenological diagnosis of a pancreatic tumor should be possible with quite the same degree of certainty as that of an abdominal tumor of any other origin.

While one must often be satisfied with evidence merely of a tumor, frequently the character of the new growth can be determined exactly. It appears that this can be done with even greater frequency in the case of pancreatic tumors than in those of the gastro-intestinal tract, for the simple reason that the incidence of benign tumors is much greater in the pancreas.

If we disregard the adenomas arising from the Langerhans cells, which due to their smallness do not produce roentgenologically recognizable signs, two main types of tumor can be distinguished in the pancreas roentgenologically: the benign cysts and the cancers. Thus, conditions reminiscent of those in the ovaries exist in the pancreas. Pancreatic cysts, like ovarian cysts, have a tendency to grow to considerable size, owing to the accumulation of fluid. As a result they are usually much larger than the carcinomas, which often

[1] Accepted for publication in March 1943.

involve the neighboring organs or metastasize to distant sites before they have grown sufficiently to produce significant local signs. Consequently, just as pylorostenosis is more pronounced in benign than in malignant lesions, so also the signs of a pancreatic cyst are, as a rule, more prominent than those of cancer of the pancreas. Besides the size of the tumor, its outlines play an important part in the differentiation between benign and malignant neoplasms. While the benign cysts grow expansively, the cancers spread by infiltration. Consequently, the cysts expand evenly in all directions, showing smooth rounded outlines. In contrast, the malignant tumors grow at different rates in various directions, so that the borders appear irregular. Furthermore, while the cystic tumors are often movable, the cancers are usually fixed by adhesions to adjacent structures. Whenever the process of fixation occurs, angular, rigid contours result.

Whether a pancreatic tumor is benign or malignant, it is roentgenologically recognizable only in so far as it is associated with an enlargement of the pancreas, and this means *expansion of the pancreatic area*. The expansion of the area occupied by the pancreas has the same significance for the diagnosis of a pancreatic tumor as the filling defect has for the diagnosis of tumors arising in hollow organs. Progress in the radiological interpretation of pancreatic tumors is reflected in the increasing number of methods devised to make evident such enlargement. The following methods have been proved of diagnostic value.

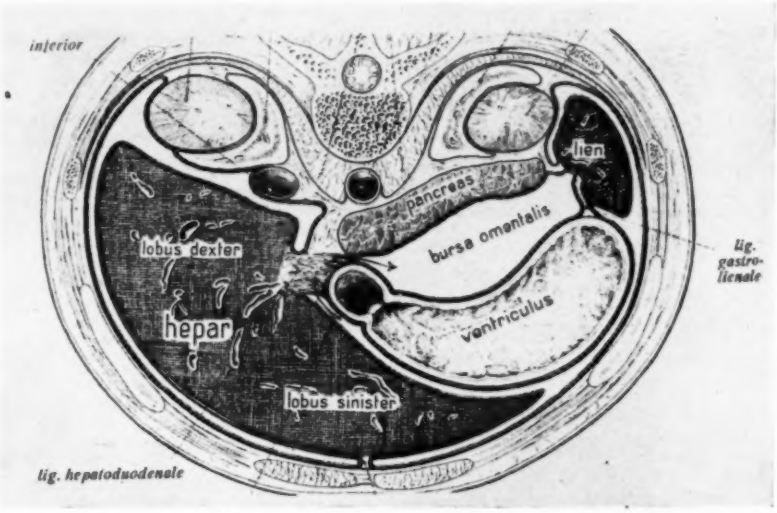

Fig. 1. Relation of pancreas to other abdominal structures (after Sobotta).

FLUOROSCOPY OF THE CHEST

Owing to the fact that the tail of the pancreas is higher than its head, while the left side of the diaphragm is lower than the right, pathologic processes occurring in the tail may give rise to changes in the left diaphragm and lung which can be readily recognized by means of fluoroscopy. There may be elevation of the diaphragm, a diminution of excursion (particularly posteriorly), or complete arrest. At the base of the lung, parallel to the diaphragm, there may appear a band-like shadow indicating an area of atelectasis. Finally, an effusion may develop, often hemorrhagic in character. These findings are encountered in inflammatory conditions as well as in malignant tumors. A carcinoma, the size

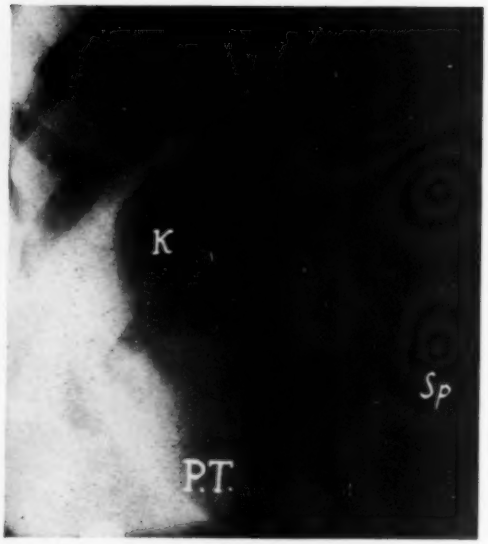

Fig. 2. Intravenous pyelogram. K. Kidney. Sp. Spinal column. P. T. Pancreatic tumor.

of a bean, in the tail of the pancreas may be associated with carcinomatosis of the pulmonary lymphatics (Kaufmann). There is probably first a reflex inhibition of respiration (Fleischner), followed by direct invasion of the diaphragm and lung. The findings are, of course, in no way characteristic of pancreatic disease and are encountered in various subdiaphragmatic conditions. When, however, they occur in the left side and there is no indication of a perinephritic process (such as fever), the pancreas should be suspected as a possible source of trouble. The importance of the symptoms mentioned lies in the fact that they may occur before any signs on the part of the gastro-intestinal tract are recognizable. In other words, pulmonary symptoms may be the initial signal of a tumor in the tail of the pancreas.

ROENTGENOGRAPHY OF THE SPINE

Since the pancreas lies directly in front of the spinal column, a pancreatic tumor can exert pressure on a vertebra or may invade it. Such involvement is usually attributed to a metastasis from a distant tumor or to primary disease of the vertebrae. However, when the process is found on the anterior surface of one of the upper three lumbar vertebrae, when the left half of the vertebra is mainly affected (since the pancreas runs from the right anteriorly to the left posteriorly), and when there are signs of pressure as well as of destruction, invasion from a neighboring pancreatic lesion should be taken into consideration. These vertebral changes are associated with tumors originating in the posterior part of the pancreas and growing continuously in a posterior direction. For this reason symptoms referable to the vertebrae may be found before any signs on the part of the gastro-intestinal tract are present, forming the first signal of a tumor localized in the body of the pancreas. In this connection the observation of Weintraub and Tuggle may be mentioned, that 6 out of 8 patients with cancer of the head of the pancreas showed a scoliosis of the lumbar spine with the curvature away from the affected side.

ROENTGENOGRAPHY OF THE ABDOMEN

It is important to know that not only pancreatic stones or abscesses but also tumors may cast distinct shadows, recognizable on plain films taken in the same manner as for demonstration of the kidneys (Fig. 2). Such tumors become visible, obviously, for the same reason as the kidneys, namely, their contrast to the retroperitoneal fat. Accordingly, the fatter the patient, the greater the likelihood of obtaining on the film a shadow which by its position and relationship to other organs may be identified as a new growth of pancreatic origin. Since in such cases the tumors are of considerable size, subsequent examination will reveal many more symptoms indicating their presence. But the abnormal shadow on the plain film may be the first evidence of a tumor beside the gastro-intestinal and urinary tract. Ehrmann, Eisler, and others have emphasized this important bit of evidence but thus far it seems not to have been given the attention it deserves.

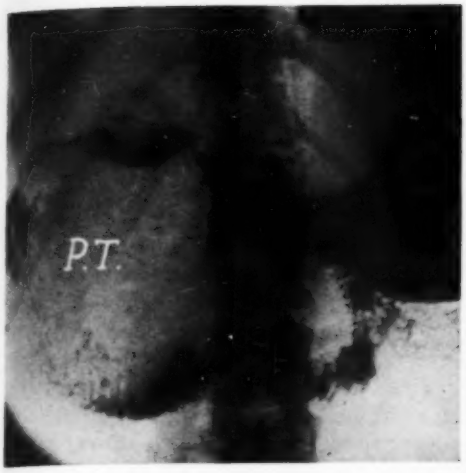

Fig. 3. Pancreatic tumor producing deformities of the normal duodenal curve.

GASTRO-INTESTINAL EXAMINATION BY MEANS OF A BARIUM MEAL

A barium study is of particular importance because of the frequent involvement of the stomach and duodenum, owing to their intimate relationship with the pancreas, and because the changes found in those organs are most characteristic of pancreatic tumors. Changes in the stomach and duodenum occur as a result of displacement, compression, or invasion.

Displacement: Tumors may be localized to discrete portions of the pancreas or may spread diffusely over parts of the organ or its entire extent. Localized lesions constitute about 70 per cent of the total; diffuse processes about 30 per cent. The localized tumors produce definite images on the x-ray film, which may be characterized briefly as follows.

Tumors arising in the *head* of the pancreas produce a characteristic horseshoe-like widening of the duodenal curve, first described by Crane in 1910. This widening is the result of displacement of all three portions of the duodenum, which hug the head of the pancreas. In addition, the antrum of the stomach is likely to be displaced upward. In this way the duodenal curve takes the form of a capital *C* in contrast to the small *c* of the normal curve (Fig. 3).

Tumors arising in the *neck* or isthmus of the pancreas, which runs to the left with a slight upward inclination behind the pyloric region, displace the preantral part of the stomach upward.

On the portion of the pancreas linking the neck to the body lies a prominence

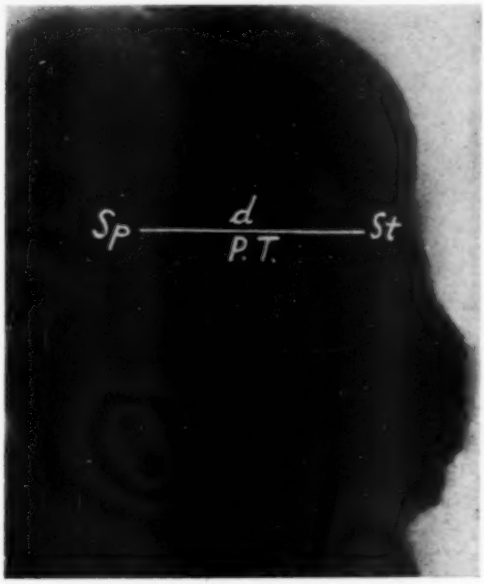

Fig. 4. Increased distance (d) between the stomach (St.) and spinal column (Sp.) due to a pancreatic tumor (P. T.).

called the *tuber omentale*, which is in opposition with the lesser curvature of the stomach above the incisura. Tumors in this region cause a displacement of the stomach to the left.

Tumors originating in the *body* of the pancreas produce a displacement of the stomach forward, thus carrying it nearer to the anterior abdominal wall and away from the vertebral column. This form of displacement is easily recognized by examination in the frontal plane, with the patient upright, supine, or lying on the right or left side. The increase in the distance between the vertebral column and the stomach is, besides the widening of the duodenal circle, the most characteristic

Fig. 5. Tumor in the body of the pancreas causing a filling defect in the stomach as a result of compression.

and most frequently encountered sign of a pancreatic tumor (Fig. 4). Examination of the stomach in the lateral view, therefore, should never be omitted, but should be done as a routine, in the course of the roentgenological examination of the gastrointestinal tract. This simple maneuver has often helped to disclose a pathologic condition in the abdomen which otherwise would have remained undetected.

Tumors developing in the *tail* of the pancreas displace the stomach to the right. If the stomach is of the steerhorn (hypersthenic) type, it is dislocated upward as well.

Wherever a displacement takes place, an arch-like outline results at the site of pressure. The arch is concave in the direction of the tumor and is smooth and sharp. It may vary considerably in size and depth. Occasionally two adjacent arches take the shape of an inverted *3* (Frostberg). Feldman labelled this sign the "three defect." It is most frequently encountered in the duodenum.

It should be added that, before the diagnosis of pancreatic tumor is made, displacements due to other factors must be precluded. Such factors include fat or fluid in the abdominal cavity, intestinal distention, enlargement of liver or spleen. Also, certain rules of technic play an important role in the interpretation of displacements. Thus the films should not be taken in the phase of deep inspiration and the patient should be in the prone position, since distortion due to enlargement may confuse the picture.

Compression: A pancreatic tumor not only displaces the stomach and duodenum, but also exerts pressure upon those organs. Compression, like displacement, is more pronounced in benign than in malignant tumors. The degree of pressure varies in proportion to the size of the tumor. Incomplete and complete obstruction may be distinguished. In the case of an *incomplete obstruction* there is some degree of retardation of the flow of barium, and a greater or less dilatation is present above the point of obstruction.

Tumors of the *head* of the pancreas may cause a constant filling of the duodenum, which normally is rapidly filled and rhythmically emptied and therefore demonstrable only for short periods.

With tumors originating in the *neck* of the pancreas, the evacuation time of the stomach is often prolonged, so that a six-hour residue may be recorded.

Tumors arising in the *body* of the pancreas are prone to produce a distortion reminding one of the so-called cascade stomach (Fig. 5). Thus the first portion of the stomach, situated above the zone of obstruction, is distinctly overfilled before spilling over into the portion below the obstruction. Occasionally the effect of obstruction extends into the esophagus above the diaphragm.

With tumors springing from the *tuber omentale* or *tail* of the pancreas, pressure on the lesser or greater curvature may produce a sort of hour-glass formation.

The filling defects produced by the pressure of the tumor may sometimes simulate a primary new growth of the stomach. The differentiation, however, is not difficult to establish if, under the fluoroscopic screen, pressure is applied to the region of gastric deformity so as to separate the tumor from the stomach. If

an extrinsic tumor is present, the filling defect disappears and the normal gastric mucosa is seen (Schlesinger, Herrnheiser, and others). The same effect may be obtained by changing the position of the patient, owing to the weight of the tumor (G. Schwarz). Thus a filling defect of the antrum seen in the erect position may disappear if viewed in the right lateral position. A filling defect of the stomach seen in the prone position may disappear with the patient erect, etc. By contrast, a primary neoplasm of the stomach is constant in appearance and remains unchanged despite the application of pressure or change in position.

A still higher degree of compression leads to *complete obstruction* characterized by prestenotic dilatation, retention of contents, and antiperistalsis. In this way the pictures of pyloric and duodenal stenosis are produced, as first described by Holzknecht and Jonas. These pictures are so well known that it is unnecessary to dwell longer on the subject.

Invasion: Invasive growth is observed, naturally, only in malignant tumors of the pancreas. Two-thirds of these occur in the head, while the rest are divided between body and tail. The more pronounced the signs of malignancy, such as rigid, angulated contours, the more easily is the differentiation made between a cancer and a cyst of the pancreas. By the same token, it becomes more difficult to decide whether we are dealing with a primary growth of the pancreas or of the gastro-intestinal tract. Since the malignant tumors are usually firmly attached to the neighboring organs, it is not possible to push them away. Hence the filling defect cannot be made to disappear on pressure or by changing the position of the patient as in benign tumors of the pancreas, which are not fixed to the stomach. Since, however, fixation of the entire new growth does not occur at once, the tumor may be pushed away in places so that by pressure or change of position the filling defect can be reduced in size, although not made to disappear completely. Furthermore, a pancreatic cancer is associated with a displacement of the stomach or duodenum, a sign foreign to primary neoplasms of the stomach. Where the displacement is not very pronounced, one still may find signs of extrinsic pressure, such as an arch-like outline of the filling defect or the "three defect." In addition, other neighboring structures, as the lung, spine, duodenojejunal angle, or colon may be displaced or compressed, events not encountered in cancers of the stomach. Finally, it should be remembered that, while the filling defect of a gastric cancer is, as a rule, limited to the stomach, that produced by a cancer of the pancreas (neck or body) often extends into the area of the duodenum and may even be most pronounced in that region. In the most frequently occurring cancers of the pancreas, those of the head, the differential diagnosis is facilitated by the fact that neoplasms in the neighboring organs, particularly in the duodenum, are extremely rare. They produce characteristic filling defects and deformities but no enlargement of the duodenal circle (Golden; Doub and Jones).

Last but not least remains the task of differentiation between pancreatic and other tumors arising retroperitoneally. This problem has been given a thorough airing from various angles, in the recent literature (Poppel; Brown; Weintraub and Tuggle; Bird; Buckstein; Butler and Ritvo). It appears that any of the tissues situated in the retroperitoneal region may give rise to a tumor or tumefaction. Thus aneurysms, hemangiomas, lipomas, fibrosarcomas, etc., have been observed. Their radiographic differentiation from pancreatic tumors is often impossible. Hence they should always be kept in mind, even though not mentioned specifically. The situation is comparable to that of a gastric neoplasm. Tumor of the stomach is the diagnosis of choice, despite the well recognized fact that identical pictures are presented by syphilis and actinomycosis, because of the rarity of these latter conditions. The same is true of pancreatic tumors in relation to retroperitoneal tumors originating out-

side the pancreas. The group of signs enumerated as characteristic for pancreatic tumor is practically identical for any retroperitoneal tumor of the upper abdomen.

Tumors arising from the *lymph nodes* are an exception to the general rule, since their frequency of occurrence equals or even exceeds that of the pancreatic tumors. They include lymphosarcomas, Hodgkin's disease, cancer, and tuberculosis. Very often they are discovered accidentally at necropsy. When they are large enough to produce clinical symptoms, they may give rise to certain roentgenological signs. By their very nature, however, they allow a certain degree of diagnostic deduction. Thus the lymphatic tumors do not give evidence of invasive growth, as do pancreatic cancers. On the other hand, they are smaller than pancreatic cysts and cause a lesser degree of displacement. In the region of the duodenum, for example, they more frequently displace single loops rather than the entire duodenal circle. In addition, the contours of lymphatic tumors are often polycyclic, forming an aggregate of "three defects." Furthermore, large lymphatic tumors, being located behind the duodenal loops, may push the duodenum forward, while pancreatic tumors never produce forward displacement, since both organs are situated at the same level, as has been stressed by Brown.

In the region of the lesser curvature pancreatic tumors cause displacement at the level of the angulus or pars media. Lymphatic tumors usually displace the fundus or pars cardia.

Very often the differential diagnosis can be established only by co-ordinating history, clinical examination, and the results of other methods of investigation. Occasionally, the effect of radiotherapy proves to be a diagnostic test of great value.

X-RAY EXAMINATION OF STOMACH AFTER INFLATION WITH GAS

Inflation with gas as an aid to roentgen examination of the stomach was introduced by Engel and Lysholm in 1933 and was described as follows: "The patient is given an ordinary effervescent powder with a mouthful of vichy water . . . . With the patient in prone position, a lateral picture is taken at once, immediately followed by one in the anteroposterior direction . . . . If a pancreatic tumor is present, the space between the posterior wall of the stomach and the anterior surface of the spinal vertebra exceeds the breadth of the corresponding vertebra . . . . In addition, the tumor causes an impression and bulges into the gas-filled stomach."

As to the value of this method, Paul remarks that "the difficulty is that it is not applicable as a routine method . . . . Unless some positive findings are present, the examiner does not know which cases may need such an added examination." Our experience is in accord with this view. We have never seen a case in which a pancreatic tumor was diagnosed only after inflation of the stomach with gas. It has been our experience that in all cases in which the method of Engel and Lysholm has given evidence of a pancreatic tumor, the diagnosis could have been made with the routine barium meal, provided lateral views were taken. In other words, the essential detail is not the filling of the stomach with gas but examination in the lateral direction. It is of secondary importance whether the lateral inspection is done with the patient upright or recumbent, prone or supine. In addition, the stomach filled with barium, photographically considered, gives a better picture than if filled with gas, which rapidly disappears. The method may be used, however, to confirm the diagnosis by furnishing certain details concerning the contours of the posterior wall of the stomach, indicating the presence of circumscribed tumors in the pancreas. It may be useful, furthermore, for the examination of the stomach in the postero-anterior direction. Such an examination may furnish interesting data concerning tumors arising at the upper border of the body and tail, since "the upper border of the corpus-cauda corresponds approximately to the transition be-

tween the fornix and the corpus of the stomach. An increase in the volume of the corpus-cauda makes a visible depression."

X-RAY EXAMINATION OF THE COLON

Pancreatic tumors of large size, bulging through the gastrocolic omentum, may cause a displacement of the colon. In most cases the displacement is downward, but in the asthenic patient with a ptotic stomach the colon may be displaced upward. There may also be a dislocation to the left. It is characteristic that the displacement does not involve the entire colon but that, as a rule, only segments are displaced: the hepatic flexure by a tumor of the head, the middle portion of the transverse colon by a tumor in the body, the splenic flexure by a tumor of the tail. This last is of particular importance because it may occur even though there is no recognizable displacement or compression of the greater curvature. The position of the transverse colon may be useful in differentiating a pancreatic from an ovarian tumor, since the latter usually displaces the entire colon upward. Besides displacement, compression of the colon may also occur.

The roentgen examination of the colon should be carried out preferably with a barium enema. In place of a barium enema, the colon may be inflated with air (Ernst).

CHOLECYSTOGRAPHY

According to Courvoisier's law, the gallbladder becomes distended when the common bile duct is occluded through the pressure of a tumor. This is in contrast to occlusion of the duct by stone, since the latter is almost invariably associated with some degree of inflammation of the gallbladder, which leads to shrinkage of this organ. Unfortunately, this important diagnostic sign is clinically evident in only about 24 per cent of the cases, according to Berk. This is mainly because the gallbladder is so frequently overlapped by an enlarged liver or obscured by a thick abdominal wall. During the course of operation, however, the gallbladder is found to be enlarged in about two-thirds of all cases (Berk).

Under these circumstances, the visualization of the gallbladder by cholecystography can be of great help in the diagnosis of a tumor located in the head of the pancreas. It was Case who suggested the use of cholecystography for this purpose in 1928. The gallbladder is found to be very large and its density very faint, obviously because the resorptive function is impaired coincidentally with distention. In addition, the emptying of the gallbladder is delayed. Sometimes the size of the organ remains unchanged after many days and even weeks, regardless of diet.

A distended gallbladder is evidence of great importance in the diagnosis of a tumor of the head of the pancreas, the more so since an enlargement of the duodenal curve is found in only about half of the cases (Rigler). It is particularly significant that pancreatic tumors occur for which the only positive radiological findings are enlargement and delayed emptying of the gallbladder. Recently Melazzi has published similar observations. It should be added, however, that an enlarged gallbladder may also be associated with an acute pancreatitis, as was first pointed out by Hultén. The clinical symptoms must therefore always be taken into consideration.

In conclusion, we may say that a pancreatic tumor too small to disturb the duodenum may yet be sufficient, if suitably situated, to occlude the common duct, with resulting gallbladder dilatation. It is consistent with radiologic experience to suspect a malignant tumor when an enlarged gallbladder is demonstrable without associated displacement of the duodenal curve. Benign tumors usually attain a size sufficient to produce changes in both the duodenal loop and in the gallbladder.

Failure of visualization of the gallbladder by no means precludes the presence of a pancreatic tumor. On the contrary, in the later stages of the disease, when the liver becomes impaired functionally and ana-

tomically, cholecystography inevitably fails to elicit a gallbladder shadow, even though subsequent autopsy shows enlargement. Non-visualization of the gallbladder may therefore serve as an indication of a far advanced, inoperable stage of neoplastic disease. Frequently jaundice is present in such cases.

Cholecystography may be useful in still another way in the diagnosis of pancreatic tumors. The contrast substance, mixed with bile, flows from the liver into the gallbladder and also directly into the intestines by way of the common duct. This phenomenon is easily demonstrated if the dye is administered by the intravenous route. Using the intravenous method, Blond and Borak showed in 1929 that the portion of dye which flows into the intestines appears in the region of the hepatic flexure about fourteen hours after administration, or at about the time when the first film of the gallbladder is taken. The same film which shows the gallbladder shows also the contrast substance in the colon. Just as filling of the gallbladder proves the patency of the cystic duct, the appearance of dye in the colon demonstrates the patency of the ductus choledochus. Thus, with the intravenous technic, cholecystography allows us to test the patency of the common duct. Absence of dye from the colon proves that the duct is blocked. This may occur with a tumor of the head of the pancreas and also with a primary tumor of the common duct. Experience has shown, however, that occlusion of the duct by external pressure will cause distention of the gallbladder, while obstruction from within will not, probably because the primary tumor soon involves the cystic duct or because of associated cholecystitis. Intravenous cholecystography thus enables us to draw certain conclusions, which may be summarized thus:

Gallbladder	Shadow in the Colon	Diagnosis
Dilated	Absent	Tumor of the head of the pancreas
Not demonstrable	Absent	Tumor of the choledochus
Not demonstrable	Present	Tumor of the gallbladder

It should be borne in mind that stones in the gallbladder or common duct may give rise to signs which are radiologically indistinguishable from those of neoplastic disease of these organs. The results of cholecystography should, therefore, never be rashly interpreted but can be properly evaluated only in connection with the clinical history, physical symptoms, and results of other methods of examination.

VISUALIZATION OF PANCREATIC DUCT

Up to now it has proved impossible to fill the pancreatic duct, or duct of Wirsung, through the papilla of Vater, as the experiments of Rietz have shown. Nor has there been found a contrast dye which, injected intravenously, is excreted through this duct.

Filling of the pancreas can as yet be accomplished only during or after operation upon the gallbladder or pancreas. During the course of a gallbladder operation the dye may be injected into the cystic duct or into the bladder itself and a film taken with a portable x-ray outfit. The aim of this procedure is to locate residual stones and to establish the patency of the entire ductal system. It is called immediate or primary cholangiography and was introduced by Mirizzi in 1932. The use of this method has permitted the visualization, not only of the bile ducts, but also of the pancreatic duct in about 20 per cent of the cases (Hickens, Best, and Hunt; Desplas, Moulonguet, and Malgras; Colp and Doubilet; Hultén). Similar observations have been possible following injection of the biliary ducts through the tubes inserted at operation. This is called delayed or secondary cholangiography and was first recommended by Lanari and Squirri in 1924.

Following these observations, it became evident that the same procedure might be useful in the diagnosis of a tumor of the head of the pancreas. Case writes: "When operation reveals a tumefaction or other evidence of disease of the head of the pancreas and the surgeon is unable to make a definite differentiation between carcinoma

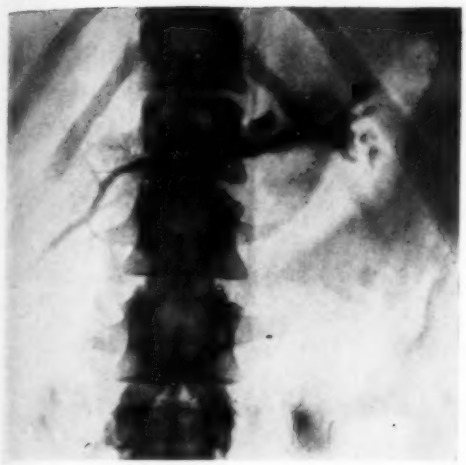

Fig. 6. Wirsung's duct filled with lipiodol injected through a postoperative fistula.

and pancreatitis, a biliary fistula may be produced for the purpose of subsequent studies in the hope that the pancreatic duct may become visualized. I have often followed this procedure. If on repeated examination the permeability of the common duct does not return, the conclusion is warranted that the stenosis is probably carcinomatous."

Demonstration of the duct of Wirsung is also possible through a fistula developing after operation for pancreatic disease. A case which came under our observation may be quoted here:

A 38-year-old woman was operated on for a pancreatic cyst. The cyst was attached to the anterior wall, incised, and drained. After a few weeks the tumor reappeared, but the operative fistula remained open, thus proving that the cyst was a product of true secretion and not of retention. In order to determine exactly the position and borders of the cyst, 20 c.c. of lipiodol were injected through the fistula. The lipiodol entered the cavity of the cyst, which proved to communicate with the duct of Wirsung. As a consequence the pancreatic duct was visualized in its entire length, with all its branches. Extending left to right with a downward inclination, the duct was dilated in the direction of the tail, evidently because of compression by the cyst (Fig. 6).

This case is apparently the first recorded in the literature in which the entire duct of Wirsung was visualized *in vivo*. It seems that as a result of the injection the communication between the cyst and the duct was dilated. Subsequently the whole viscous content of the cyst was evacuated through the duct into the intestines. The cyst collapsed and the duodenal curve, which was enlarged, regained its normal shape. Thus the injection was of value both diagnostically and therapeutically.

PNEUMOPERITONEUM

Pneumoperitoneum, recommended by Hessel in 1922, calls for the introduction of a gas into the abdominal cavity. This enables us radiologically to trace the outlines of the various abdominal organs. This procedure, however, is associated with a great many inconveniences and even dangers to the patient. It has been generally abandoned with the advent of the other methods, described above.

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CASE REPORTS

Giant Gastric Rugae with Diffuse Hypertrophic Gastritis: A Case Resembling A Neoplasm on the Lesser Curvature of the Stomach[1]

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Giant gastric mucosal folds demonstrable roentgenographically are the most characteristic sign of hypertrophic gastritis. Of rare occurrence and of unusual interest in this form of gastritis is a filling defect on the greater or lesser curvature which closely resembles the defect produced by a neoplasm.

Ordinarily, when the normal stomach is completely filled with an opaque medium, the curvatures are sharply outlined. Occasionally the greater curvature will show a slight serration due to the prominence of the normal mucosal folds. The lesser curvature, however, is usually smooth in contour with no serrations. This absence of serrations is due to the structural formation of the mucosal folds, which on the lesser curvature side of the stomach are closely attached to the submucosa and underlying structures. The fact that the rugae run parallel with the long axis of the stomach also tends to prevent the appearance of serrations. The mucosa of the greater curvature, on the other hand, is loosely attached, the folds are thrown into convolutions, and the rugae lie more or less obliquely, at right angles to the curvature, and are thus more likely to produce shallow serrations normally. Large pliable mucosal folds may also be observed at times on the greater curvature, producing a crenulated appearance. These ordinarily have no clinical significance. When the folds are excessively redundant they may produce a filling defect simulating a neoplasm.

In hypertrophic gastritis the gastric mucosal folds are greatly thickened, indurated, and enlarged and thus tend to produce an exaggerated serration with broad, deep, sharp notches. The lesser curvature is ordinarily unchanged in appearance, notwithstanding the fact that the folds are pathologically enlarged, though occasionally in advanced hypertrophic gastritis with hyperplasia producing nodular polypoid-like excrescences, the relief roentgenogram may show some irregularity,

In cases in which localized giant gastric rugae are associated with hypertrophic gastritis a filling defect may be observed on the *greater curvature* of the stomach resembling that caused by a neoplasm. Giant gastric rugae producing such a filling defect are rare. Kantor described two cases found in over 2,500 patients examined roentgenologically and cited Windholz as discovering 2 examples in 3,000 autopsies, and Cole and Scherer as each reporting 4 cases. The incidence of giant gastric rugae which produce a neoplastic type of filling defect on the *lesser curvature* must be exceedingly low. In over 25,000 patients examined roentgenologically, I have observed such a defect only once, nor have I been able to find any case in the available literature. The few cases recorded have all involved the greater curvature.

CASE REPORT

A man, aged 33, was admitted to the Sinai Hospital complaining of a stomach disorder of three years' duration, with intermittent epigastric pains, which had recently become more intense, especially during the night. The pain was not related to food. Two years previously the patient had an appendectomy. He had lost thirty pounds in weight and had experienced progressive weakness, loss of strength, and loss of appetite.

Physical examination revealed nothing unusual. The abdomen was soft with no palpable mass. Urinalysis and a complete blood study were negative. Gastric analysis yielded the following data: the alcohol test meal showed a total acidity of 6 and no free hydrochloric acid; the histamine test showed a total acidity of 70, and free hydrochloric acid 49. A routine roentgenologic investigation of the digestive tract revealed a large invasive type of

[1] From the Sinai Hospital, Baltimore, Md. Accepted for publication in February 1943.

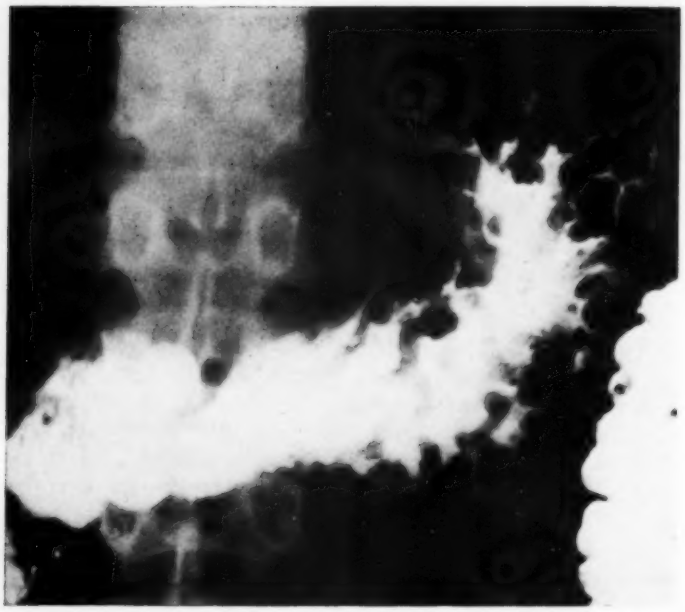

Fig. 1. Relief roentgenogram showing the large shallow filling defect on the lesser curvature of the stomach (arrow). Note the enlarged mucosal rugae and the wide, deep, sharp rugal folds along the greater curvature.

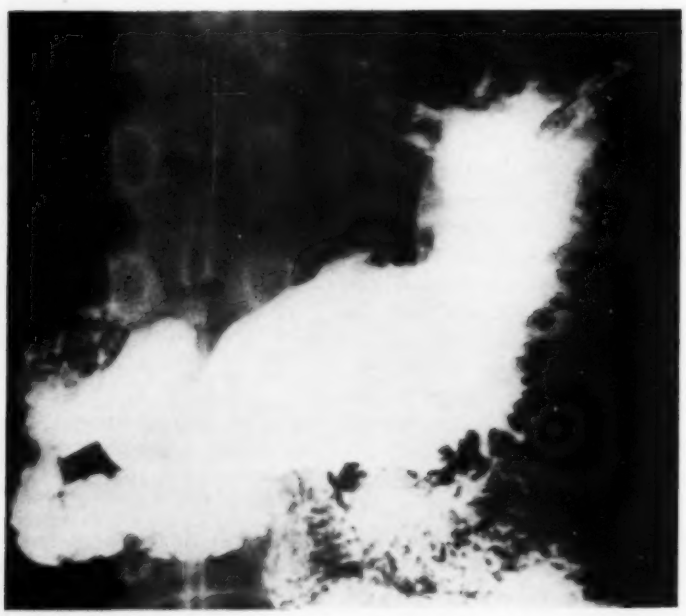

Fig. 2. The completely filled stomach shows a large punched-out filling defect on the lesser curvature (arrow). Note the saw-tooth contour of the greater curvature due to the enlarged mucosal folds.

neoplastic filling defect on the lesser curvature of the stomach. A relief roentgen study of the gastric mucosa showed thickening and induration of the folds characteristic of a hypertrophic gastritis. The mucosal serrations along the greater curvature were greatly exaggerated; the folds were deepened, widened, and sharply contoured, producing a saw-tooth appearance. The pylorus was negative; the duodenal bulb was dilated and atonic, and on compression showed a clearly demonstrable ulcer niche defect. On the basis of the roentgen findings a diagnosis was made of a neoplastic gastric defect on the lesser curvature, resembling a benign tumor associated with a hypertrophic gastritis; also duodenal ulceration with an atonic duodenal bulb.

At operation, the interior of the stomach was found to be filled with giant mucosal rugae, measuring approximately 1.0 cm. in width and 2.5 cm. in depth, projecting into the lumen of the stomach. On exploring the interior of the stomach, no neoplasm was found. A biopsy specimen removed from the lesser curvature at the site of the roentgen defect showed gastric glands of the fundal type. Within the tunica propria of the mucosa were scattered small collections of lymphocytes and occasional plasma cells. The submucosa and muscularis showed nothing abnormal. The pathological diagnosis was chronic gastritis.

DISCUSSION

An intrinsic neoplastic type of filling defect in the contour of the stomach other than that due to organic neoplastic disease is exceedingly rare. In most instances a roentgenologic diagnosis of carcinoma or other growth arising in the interior of the stomach is made. In the differential diagnosis, both benign and malignant tumors must be excluded and differentiated from redundant prolapsing gastric mucosa, hypertrophic gastritis, and inflammatory disease of the stomach. The diagnostic difficulty in the consideration of this condition lies in the fact that roentgenologically gastritis may mimic other diseases. There are a number of points, however, which enable one to make an accurate diagnosis. Clinically a few signs are helpful, such as evidence of long duration of the disease, the absence of a palpable mass, and the presence of acid in the stomach. In the roentgen examination the demonstration of giant mucosal rugae associated with a diffuse hypertrophic gastritis should lead one to suspect that the latter condition may be the causative factor in the production of the filling defect. In the case presented in this report, the filling defect had none of the usual characteristics of carcinoma; it was smooth in contour and was more characteristic of a benign tumor. It should be pointed out that filling defects in the contour of the stomach, when associated with hypertrophic gastritis presenting giant rugae, should be interpreted with caution, since the therapy must of necessity be conservative.

SUMMARY

An unusually rare case of giant gastric rugae, associated with a diffuse hypertrophic gastritis is reported in this communication. Of particular interest is the occurrence of a neoplastic type of filling defect on the lesser curvature of the stomach.

Roentgen defects produced by giant gastric rugae may mimic those due to a neoplasm. Filling defects in the gastric contour associated with giant mucosal rugae and diffuse hypertrophic gastritis should be interpreted with a full knowledge of the clinical findings as well as the benefit of a gastroscopic examination in order to avoid unnecessary surgical exploration.

2425 Eutaw Place
Baltimore, Md.

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Postoperative Biliary Tract Visualization[1]

STEPHEN N. TAGER, M.D.

Director of Roentgenology, Burnham City Hospital, Champaign, Ill.

A review of the literature on the subject of biliary fistula reveals that the most frequent cause of its persistence is obstruction

[1] Accepted for publication in February 1943.

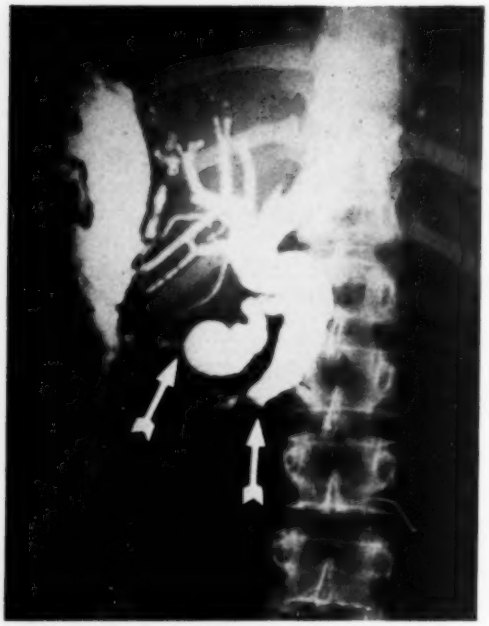

Fig. 1 Roentgenogram showing site of previous rupture of gallbladder, obstruction at ampulla of Vater, and large sinus tract.

of the common duct and ampulla of Vater (Cotte; Overholt; Shelley; Doubilet). In the following case, in addition to showing evidence of obstruction, the roentgenogram revealed, also, an abscess pocket at the site of previous rupture of the gallbladder.

For the physiological principles of roentgen visualization of the biliary tract after injection of lipiodol, the reader is referred to the excellent article of Doubilet. His assertion deserves repetition at this time: "In short, if lipiodol enters the duodenum without visualization of the hepatics, the sphincter tone is normal or low. If the hepatic ducts are visualized before the lipiodol can be forced into the duodenum, the sphincter is spastic."

CASE HISTORY

Mrs. D. S., white, aged 30, had experienced the usual childhood diseases. She had a tonsillectomy at the age of ten and an appendectomy at the age of twelve. She had four children, all in good health.

For two years the patient had suffered recurrent attacks of indigestion with eructations, which had gradually become more severe. Following an acute attack with pain in the right upper quadrant, she entered the county hospital in March 1942, where gallbladder drainage was done and a calculus was removed from the fundus of the gallbladder. A large amount of fecal material was obtained, but the tissues were so friable that exploration was deemed inadvisable.

After four weeks the patient was discharged. Subsequently a draining sinus developed. This closed over from time to time, and severe pain and nausea followed within thirty-six to forty-eight hours. The sinus would then reopen, there would be considerable drainage of bile, and the patient would experience relief. The stools at this time were gray in color, indicating absence of bile.

On June 28, 1942, the patient entered Burnham City Hospital for x-ray studies to determine the source of the obstruction and extent of the draining sinus. She now weighed 95 or 100 pounds, having previously weighed about 150. She was pale, emaciated and weak, and complained of *severe epigastric distress simultaneously with sinus closure.* Examination showed the scar from the earlier operation with a draining sinus in the right upper quadrant. This area was tender on pressure. No abdominal masses were palpable.

Blood studies (June 29) showed hemoglobin 88 per cent (13.3 gm.); color index 1; 4,520,000 red cells; 12,900 white cells with the following differential count (Schilling): neutrophils, 69; lymphocytes 27; segmented forms 66; large mononuclear leukocytes 4; myelocytes 1; juvenile forms, 1; stab forms 3. The stools showed a faint trace of urobilinogen. Urinalyses (June 27 and July 6) showed the presence of pus cells. The Kahn test was negative.

Fluoroscopic and roentgenographic examination of the gallbladder region (July 8) with the aid of iodochloral (40 c.c.) injected through a fine rubber catheter projecting into the biliary fistula, showed a large pocket of the contrast substance in the right upper quadrant, evidently the site of the previous abscess. The gallbladder and cystic duct were clearly demonstrated (Fig. 1).

Diagnosis: Large sinus tract in the gallbladder region; obstruction in the common bile duct at the ampulla of Vater.

On July 13, the sinus again closed and the patient experienced severe pain in the gallbladder area, accompanied by extreme nausea.

Operation was done on July 18. The gallbladder was shrunken, thickened, and indurated, connecting with the fistula, which was covered by adherent tissues. Cholecystectomy was done. The cystic duct was opened and the incision extended into the common duct, which was then dilated and explored. Two catheters were placed in the common bile duct, one upward and one downward to the duodenum. Each was sutured into position. A Penrose drain was inserted. An obstruction at the ampulla of Vater was noted, resistance to the catheter being

encountered at this point. This confirmed the x-ray diagnosis. A T-tube was inserted in the common bile duct. Recovery was uneventful.

Pathological Diagnosis: Chronic cholecystitis.

It is apparent that the recurring episodes of drainage, followed by relief, were due to the emptying of the large sinus tract. This subsequently refilled with bile, through the patent gallbladder, became distended, and caused the pain and nausea.

SUMMARY

A case is presented in which the entire biliary tract was visualized. The small indurated gallbladder showed the site of previous rupture at its dome. A large sinus tract in the right upper quadrant was seen communicating with the gallbladder. Finally a marked dilatation of the common bile duct, due to obstruction at the ampulla of Vater, was noted. The demonstration of these three significant findings on the one roentgenogram is rather unusual and offers further confirmation of the physical principles of biliary tract visualization.

Note: The writer thanks Dr. Glenn Fischel of Tolono and Dr. John Gernon of Champaign for permission to study this case.

Burnham City Hospital
Champaign, Ill.

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Unusual Intercarpal Dislocation[1]

ARTHUR A. BREWER, M.D., and OSCAR C. ZINK, M.D.

Speed's classification of carpal dislocations includes an intercarpal group, defined as occurring between the distal and proximal rows of carpal bones. While any dislocation of the intercarpal articulation is uncommon, in most instances in which it does occur the distal carpal row is displaced posteriorly. In the case to be recorded here the chief displacement of the distal row was to the ulnar side. A review of the English literature for the past fifteen years failed to reveal any reference to a similar dislocation.

Fig. 1. Intercarpal dislocation, with medial displacement of the distal carpal row.

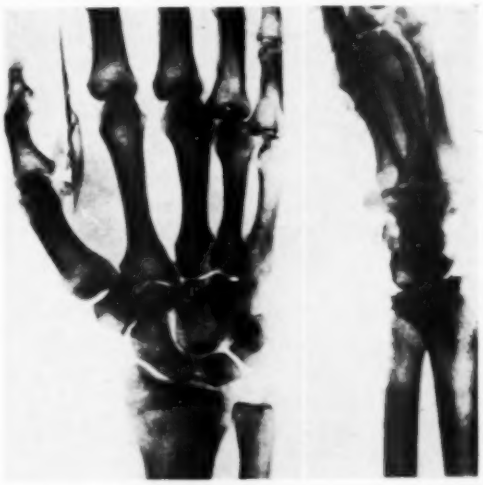

Fig. 2. Post-reduction roentgenograms, showing normal carpal relations.

A 43-year-old male, an oil field worker, presented himself because of injuries to the right hand and

[1] From the Department of Radiology, St. Luke's Hospital, St. Louis, Mo. Case presented through courtesy of Dr. E. V. Mastin, Chief of Surgical Service. Accepted for publication in February 1943.

wrist, sustained two hours previously. While working with an oil pump, he had fallen, and the right forearm and hand had been caught between a flywheel and the arm of the pump. Specific details as to the mechanism of the injury could not be elicited, but apparently the forearm had been held firmly while force was exerted on the hand and wrist. The patient gave a history of three previous fractures of the right wrist, but details were not available. There was no roentgen evidence of old fracture.

Swelling of the wrist and hand was so great that on examination no actual deformity was apparent. There was a transverse laceration on the posterior aspect of the wrist; several tendon sheaths were cut, but no actual injury of the tendons was demonstrable. Generalized pain and tenderness were severe. Fingers were held in partial flexion and there was limitation of all movements of the wrist, hand, and fingers.

Postero-anterior and lateral roentgenograms (Fig. 1) showed medial and posterior dislocation of the distal carpal row. The extent of medial shift was best indicated by the position of the capitate, which lay 1.5 cm. medial to the medial articulating surface of the navicular. There was no evidence of fracture. The radiocarpal and carpometacarpal relations were normal.

Under general anesthesia the dislocation was reduced. While a moderate continuous traction was maintained, the hand was adducted and extended and the dislocated carpal bones readily fell into normal position. The soft tissue injuries were repaired and the joint immobilized on a volar splint.

Post-reduction roentgenograms (Fig. 2) showed normal carpal relations.

In one week the soft tissue injuries had healed and the patient was discharged from the hospital. Immobilization was continued two weeks more and the splint was then replaced by a leather wrist support for an additional two weeks.

When the patient was last seen, seven weeks after the original injury, the attending surgeon estimated that at least 95 per cent normal function was present, and that no permanent disability was to be expected.

712 State St., Alton, Ill.

REFERENCE

SPEED, KELLOGG: A Text-book of Fractures and Dislocations. Lea & Febiger, 4th ed., 1942, p. 625.

EDITORIAL

Howard P. Doub, M.D., Editor

John D. Camp, M.D., Associate Editor

Pernicious Anemia and the Early Diagnosis of Carcinoma of the Stomach

The conception that carcinoma of the stomach and pernicious anemia are closely related has been held for a great many years, and much effort has been expended upon the study of these two diseases with a view to determining whether they have a common etiology or a common precursor. There is much evidence to support the theory that there is a type of gastric mucous membrane which is likely to result in pernicious anemia and that the same type of mucous membrane is conducive to the development of carcinoma of the stomach. This theory presupposes that the achlorhydria found in both pernicious anemia and carcinoma precedes the two diseases. Whether this mucosal abnormality is the result of a chronic gastritis with a secondary atrophy or is a primary atrophy on a familial basis is not fully established. The co-existence of the two diseases is thus not one of cause and effect or simply coincidence, but rather the result of a common precursor.

The reports of the occurrence of carcinoma of the stomach in patients with pernicious anemia have increased sharply during the past decade. In part, this is the result of better observation, owing to the more common use of roentgen examination of the stomach; but also it is a consequence of the institution of liver therapy, which prolongs the life of patients with pernicious anemia, thus enabling carcinoma to develop.

The search for a method leading to the early diagnosis of carcinoma of the stomach has proceeded apace for many years without new or startling events. There is no doubt that adequate roentgen examination of the stomach, supplemented when necessary by gastroscopy, represents the best procedure available at the present time. Yet, any honest appraisal of the facts will reveal that relatively few carcinomas of small size are thus uncovered. Many early carcinomas, some less than 1 cm. in diameter, and even small benign tumors of the stomach have been observed by the roentgen method, but the vast majority of cases coming to the roentgenologist for examination are advanced and are relatively easy to determine. Carcinoma of the stomach is an insidious disease, too often producing symptoms of insufficient gravity to stimulate careful investigation, so that it is commonly in a late stage when examination is undertaken. How accurate would roentgen examination and gastroscopy prove to be if routine studies of the stomach were done on symptomless individuals, such as is now a common undertaking in the search for tuberculosis? Would the accuracy approach the results achieved in survey examinations of the chest?

Some years ago, in the hope of clarifying this problem, we contemplated an experimental survey of persons past the age of forty by means of semi-annual roentgen examinations of the stomach. A glance at the incidence of carcinoma of the stomach in the living population, however, served as a potent deterrent for such an undertaking. While the statistics on the occurrence of internal cancer in the living population are necessarily somewhat inaccurate, yet it seems probable that not more than three persons per thousand, over the age of forty-five, are afflicted with

gastric carcinoma. The productivity of such a study, therefore, seemed too slight to justify the time and expense involved. We felt, however, that if there should exist a selected group of individuals in whom carcinoma of the stomach would be likely to be present in as many as 5 per cent, such an undertaking would be eminently worth while.

Believing that the data then available indicated a greater frequency of carcinoma of the stomach in patients with pernicious anemia, we began, in 1939, an attempt to re-examine all pernicious anemia patients at six-month intervals. We hoped to find some early tumors of the stomach in patients without symptoms or signs whatever.

The results of this study, which will be published in more detail later, indicate clearly that carcinoma of the stomach is far more common, probably ten times as common, in patients with pernicious anemia than in the rest of the population. Furthermore, it is evident that benign epithelial tumors are likewise far more frequent in such cases. By this procedure we have been able to demonstrate some small carcinomas of the stomach. We have also had the interesting experience of observing polypi, apparently benign both roentgenologically and gastroscopically, develop into obvious carcinoma following the refusal of the patient to have the tumor extirpated. The number of patients without symptoms or signs related to the stomach who exhibited fairly obvious tumors was startling and has more than confirmed the impression that carcinoma of the stomach is extremely insidious in its onset.

From the data which we have now collected, it is perfectly clear that every patient with pernicious anemia should have a roentgen examination of the stomach at least every six months. It is significant that a large growth was found in some patients who, but one year before, appeared to have a normal stomach. The tendency of gastric carcinoma suddenly to undergo marked enlargement is well known and indicates the necessity for examinations even more often than yearly, if the lesion is to be found at an early stage. In our small series there has already occurred a real salvage from the disease. Considering that patients with pernicious anemia, when properly treated, may outlive their expectancy, the surgical treatment of an early cancer, or a benign polyp which may likely develop into cancer, is thoroughly worth while. Furthermore, we are rapidly learning the real utility and limitations of roentgen examination in the diagnosis of small tumors of the stomach.

LEO G. RIGLER, M.D.

ANNOUNCEMENTS AND BOOK REVIEWS

ANNUAL MEETING RADIOLOGICAL SOCIETY OF NORTH AMERICA

Members of the Radiological Society of North America are reminded once again of the Annual Meeting to be held in Chicago, at the Drake Hotel, Nov. 29–Dec. 3, 1943.

New Faculty Building, Buenos Aires, in which the sessions of the Inter-American Radiological Congress will be held, Oct. 17–22, 1943. This is but a part of a large construction project to be known on completion as the Policlinica San Martin.

INTER-AMERICAN CONGRESS OF RADIOLOGY

On the program of the forthcoming Inter-American Congress of Radiology, notices of which have appeared in earlier issues of this Journal, appear the following names: Dr. Di Rienzo of Argentina, Dr. Opazo of Chile, and Dr. Caminha of Brazil, speaking on the Diagnosis of Spinal Infections; Dr. Butler of Uruguay, Dr. Guzmán of Chile, Dr. Nelson de Carvalho of Brazil, Dr. Puente Duany and Dr. Fonts Abreu of Cuba, on Carcinoma of the Breast; Dr. Maissa of Argentina, Dr. Esguerra Gómez of Colombia, and Dr. J. J. Vallarino of Panama on Roentgenography of the Gastro-Intestinal Tract; Dr. Oscar Soto of Peru on the Teaching of Radiology in America. The papers will be discussed by other eminent Latin-American radiologists.

The sessions of the Congress will be held in the new Faculty Building, Buenos Aires, Oct. 17–22, 1943. Members of the Radiological Society of North America desiring to attend should arrange with Dr. Donald S. Childs, Secretary of the Society, to obtain proper credentials.

WASHINGTON STATE RADIOLOGICAL SOCIETY

At a recent meeting of the Washington State Radiological Society, Dr. F. B. Exner of the Medical Dental Meeting of Seattle was re-elected President, and Dr. Thomas Carlile of Seattle was elected Secretary-Treasurer.

Dinner given by the Radiological Section of Los Angeles County Medical Association, honoring Captain Albert Soiland, May 5, 1943

HONORS FOR CAPTAIN ALBERT SOILAND, M.C., U.S.N.R.

On Wednesday, May 5, the Radiological Section of the Los Angeles County Medical Association celebrated the seventieth birthday of Capt. Albert Soiland, M.C., U.S.N.R., with a testimonial dinner at the University Club. About one hundred and fifty of Captain Soiland's friends were present, including Rear Admiral Ralston Holmes, U.S.N., Capt. W. H. Michael, M.C., U.S.N., The Honorable Fletcher Bowron, Mayor of Los Angeles, The Honorable Erling S. Bent, Norwegian Consul, Capt. Iverson, U.S.N., Capt. John Ruddock, M.C., U.S.N.R., Capt. Walters, U.S.N., and Capt. Wm. Costolow, M.C., U.S.N.R.

Congratulatory messages were received from the Crown Prince and Princess of Norway, the Norwegian Ambassador to the United States, Admiral Chester W. Nimitz, CINPAC, Rear Admiral Ross McIntyre, Surgeon General of the United States Navy, Admiral Wm. D. Leahy, Chief of Staff to the President, and many others.

Following a pleasant program of entertainment the principal address of the evening was given by Commander John D. Camp, M.C., U.S.N.R., whose subject was "The Origin and Development of the Science of Roentgenology."

Doctor Soiland was presented with an engrossed scroll bearing the signatures of all those present and responded with words of appreciation. At the culmination of the evening Capt. W. Howard Michael M.C., U.S.N., presented the fourth gold stripe, elevating Doctor Soiland from the rank of Commander to the rank of Captain in the United States Navy.

A SUGGESTION TO CONTRIBUTORS

It has been suggested, in the interest of our Latin-American and other foreign colleagues, that illustrations appearing in RADIOLOGY do not carry on the face of the cut itself any legend or inscription beyond letters or figures which may be explained in the accompanying caption. An ever-increasing number of scientific papers are being translated into Spanish, Portuguese, and other languages. Cuts in which an English legend is actually incorporated must be re-made to illustrate such papers, while those bearing simply alphabetical or numerical keys can be re-used with benefit to all concerned. It is asked that our contributors bear this in mind.

ERRATUM

An unfortunate error occurs in the January 1943 issue of RADIOLOGY. In the legend of Figure 5, page 45, in the paper by Joseph Gordon and Henry K. Taylor, on "The Post-Thoracoplasty Roentgenogram with Special Reference to Posture," the preoperative intracavitary manometric readings are given as -3 and -8. These figures should be $+3$ and $+8$.

In Memoriam

CHARLES VALLANDIGHAM GENOWAY

1863–1943

Dr. Charles V. Genoway, pioneer roentgenologist in Idaho, died at the age of eighty years, on June 18, 1943. Doctor Genoway was born in Cincinnati and was graduated from the Medical School of Cincinnati University in 1888. He moved to Wallace, Idaho, in 1892. Subsequently he spent some time in Paris and Vienna and in the latter city studied with Wilhelm Conrad Roentgen. From 1912 he practised in Boise, Idaho, where for nearly thirty years he was roentgenologist at St. Alphonsus Hospital. He was a member of the Radiological Society of North America.

Book Review

CLINICAL ROENTGENOLOGY OF THE CARDIOVASCULAR SYSTEM. By HUGO ROESLER, M.D., F.A.C.P., Associate Professor of Roentgenology and Cardiologist, Department of Medicine, Temple University School of Medicine; Cardiologist, Temple University Hospital, Philadelphia, Penna. Second edition. A volume of 480 pages, with 337 figures and 2,575 references. Published by Charles C Thomas, Springfield, Ill. Price $7.50.

In this second edition the author has improved and added to the text of a volume which has already received wide acclaim as a basic contribution to the subject of cardiovascular roentgenology. As an instance of the major additions we mention the new material in Chapter I on types of apparatus; technic of chest roentgenography; technic of visualization of heart, pulmonary circulation, and great vessels; technic of postmortem roentgenography of coronary artery circulation. There are 62 new references in the bibliography concluding this chapter, and 2 new illustrations. Other chapters have similar additions.

The text is liberally interspersed with illustrative case reports. The roentgenographic and photographic illustrations accompanying these are well chosen and instructive. An unusually complete bibliography is printed at the end of each chapter.

As the title implies, there is ample discussion of the clinical aspects of the subject. The objective roentgen changes are explained on a physiologic basis. The description of the various conditions is logical in development, practical, and complete The book can be fully recommended to all roentgenologists and others who are interested in the cardiovascular system.

RADIOLOGICAL SOCIETIES OF NORTH AMERICA

Editor's Note.—Will secretaries of societies please cooperate by sending information to Howard P. Doub, M.D., Editor, Henry Ford Hospital, Detroit, Mich.

UNITED STATES

Radiological Society of North America.—Secretary, D. S. Childs, M.D., 607 Medical Arts Building, Syracuse, N. Y.

American Roentgen Ray Society.—Secretary, Harold Dabney Kerr, M.D., Iowa City, Iowa.

American College of Radiology.—Secretary, Mac F. Cahal, 540 N. Michigan Ave., Chicago, Ill.

Section on Radiology, American Medical Association.—Secretary, J. T. Murphy, M.D., 421 Michigan St., Toledo, Ohio.

ARKANSAS

Arkansas Radiological Society.—Secretary-Treasurer, J. S. Wilson, M.D., Monticello. Meets every three months and annually at meeting of State Medical Society.

CALIFORNIA

California Medical Association, Section on Radiology.—Secretary, Joseph D. Coate, M.D., 434 Thirtieth St., Oakland.

Los Angeles County Medical Association, Radiological Section.—Secretary, Donald R. Laing, M.D., 65 N. Madison Ave., Pasadena. Meets second Wednesday of each month at County Society Building.

Pacific Roentgen Society.—Secretary-Treasurer, L. Henry Garland, M.D., 450 Sutter St., San Francisco. Society meets annually during annual meeting of the California Medical Association.

San Francisco Radiological Society.—Secretary, Sydney F. Thomas, M.D., San Francisco Hospital. Meets monthly on third Thursday at 7:45 P.M., in Toland Hall, University of California Hospital.

COLORADO

Denver Radiological Club.—Secretary, Edward J. Meister, M.D., 366 Metropolitan Bldg. Meetings third Friday of each month at the Denver Athletic Club.

CONNECTICUT

Connecticut State Medical Society, Section on Radiology.—Secretary-Treasurer, Max Climan, M.D., 242 Trumbull St., Hartford. Meetings bimonthly, on second Thursday. Place of meeting selected by Secretary.

FLORIDA

Florida Radiological Society.—Acting Secretary, Walter A. Weed, M.D., 204 Exchange Building, Orlando.

GEORGIA

Georgia Radiological Society.—Secretary-Treasurer, James J. Clark, M.D., 478 Peachtree St., N. E., Atlanta. Meetings twice annually, in November and at the annual meeting of State Medical Association.

ILLINOIS

Chicago Roentgen Society.—Secretary, Warren W. Furey, M.D., 6844 S. Oglesby Ave. Meets at the Palmer House, second Thursday of October, November, January, February, March, and April.

Illinois Radiological Society.—Secretary-Treasurer, William DeHollander, M.D., St. Johns' Hospital, Springfield. Meetings quarterly by announcement.

Illinois State Medical Society, Section on Radiology.—Secretary, Fay H. Squire, M.D., 1753 W. Congress St., Chicago.

INDIANA

The Indiana Roentgen Society.—Secretary-Treasurer, Harold C. Ochsner, M.D., Methodist Hospital, Indianapolis. Annual meeting in May.

IOWA

The Iowa X-ray Club.—Holds luncheon and business meeting during annual session of Iowa State Medical Society.

KENTUCKY

Kentucky Radiological Society.—Secretary-Treasurer, Sydney E. Johnson, M.D., Louisville City Hospital, Louisville. Meeting annually in Louisville, third Saturday afternoon in April.

LOUISIANA

Louisiana Radiological Society.—Secretary-Treasurer, Johnson R. Anderson, M.D., North Louisiana Sanitarium, Shreveport. Meets annually at same time as State Medical Society.

Shreveport Radiological Club.—Secretary-Treasurer, R. W. Cooper, 940 Margaret Place. Meetings monthly on the second Wednesday, at the offices of the various members.

MARYLAND

Baltimore City Medical Society, Radiological Section.—Secretary, Walter L. Kilby, M.D., 101 W. Read St. Meetings are held the third Tuesday of each month.

MICHIGAN

Detroit X-ray and Radium Society.—Secretary-Treasurer, E. R. Witwer, M.D., Harper Hospital, Detroit. Meetings first Thursday of each month from October to May, inclusive, at Wayne County Medical Society club rooms, 4421 Woodward Ave., Detroit.

Michigan Association of Roentgenologists.—Secretary-Treasurer, E. M. Shebesta, M.D., 1429 David Whitney Bldg., Detroit. Meetings quarterly by announcement.

MINNESOTA

Minnesota Radiological Society.—Secretary, John P. Medelman, M.D., 572 Lowry Medical Arts Bldg., St. Paul. Meetings quarterly.

MISSOURI

Radiological Society of Greater Kansas City.—Secretary, Arthur B. Smith, M.D., 306 E. 12th St., Kansas City, Mo. Meetings last Thursday of each month.

The St. Louis Society of Radiologists.—Secretary, Paul C. Schnoebelen, M.D., 462 N. Taylor Ave. Meets on fourth Wednesday of each month except June, July, August, and September, at a place designated by the president.

NEBRASKA

Nebraska Radiological Society.—Secretary, F. L. Simonds, M.D., 1216 Medical Arts Bldg., Omaha. Meetings third Wednesday of each month at 6 P.M. in either Omaha or Lincoln.

NEW ENGLAND

New England Roentgen Ray Society (Maine, New Hampshire, Vermont, Massachusetts, and Rhode Island).—*Secretary,* Hugh F. Hare, M.D., Lahey Clinic, Boston, Mass. Meets monthly on third Friday at Boston Medical Library.

NEW JERSEY

Radiological Society of New Jersey.—Secretary, H. J. Perlberg, M.D., Trust Co. of New Jersey Bldg., Jersey City. Meetings at Atlantic City at time of State Medical Society and midwinter in Newark as called by president.

NEW YORK

Associated Radiologists of New York, Inc.—Secretary, William J. Francis, M.D., 210 Fifth Ave., New York City. Regular meetings the first Monday evening of the month in March, May, October, and December.

Brooklyn Roentgen Ray Society.—Secretary-Treasurer, Leo Harrington, M.D., 880 Ocean Ave. Meetings held the fourth Tuesday of every month, October to April.

Buffalo Radiological Society.—Secretary-Treasurer, Joseph S. Gianfranceschi, M.D., 610 Niagara St. Meetings second Monday evening each month, October to May, inclusive.

Central New York Roentgen Ray Society.—Secretary-Treasurer, Carlton F. Potter, M.D., 425 Waverly Ave., Syracuse. Meetings are held in January, May, and October, as called by Executive Committee.

Long Island Radiological Society.—Secretary, Marcus Wiener, M.D., 1430 48th St., Brooklyn. Meetings fourth Thursday evening each month at Kings County Medical Bldg.

New York Roentgen Society.—Secretary, Haig H. Kasabach, Presbyterian Hospital, New York, N. Y.

Rochester Roentgen-ray Society.—Secretary, S. C. Davidson, M.D., 277 Alexander St. Meetings at convenience of committee.

NORTH CAROLINA

Radiological Society of North Carolina.—Secretary-Treasurer, Major I. Fleming, M.D., 404 Falls Road, Rocky Mount. Meeting with State meeting in May, and meeting in October.

NORTH DAKOTA

North Dakota Radiological Society.—Secretary, L. A. Nash, M.D., St. John's Hospital, Fargo. Meetings by announcement.

OHIO

Ohio Radiological Society.—Secretary, J. E. McCarthy, M.D., 707 Race St., Cincinnati. The next meeting will be held at the time and place of the annual meeting of the Ohio State Medical Association.

Cleveland Radiological Society.—Secretary-Treasurer, J. O. Newton, M.D., 13921 Terrace Road, East Cleveland. Meetings at 6:30 P.M. at the Mid-day Club, in the Union Commerce Bldg., on fourth Monday of each month from October to April, inclusive.

Radiological Society of the Academy of Medicine (Cincinnati Roentgenologists).—*Secretary-Treasurer,* Samuel Brown, M.D., 707 Race St. Meetings held third Tuesday of each month.

PENNSYLVANIA

Pennsylvania Radiological Society.—Secretary-Treasurer, L. E. Wurster, M.D., 416 Pine St., Williamsport. The Society meets annually.

The Philadelphia Roentgen Ray Society.—Secretary, Robert P. Barden, M.D., 3400 Spruce St., Philadelphia. Meetings held first Thursday of each month at 8:15 P.M., from October to May, in Thomson Hall, College of Physicians, 21 S. 22nd St., Philadelphia.

The Pittsburgh Roentgen Society.—Secretary-Treasurer, Reuben G. Alley, M.D., 4800 Friendship Ave., Pittsburgh, Pa. Meetings are held on the second Wednesday of each month at 4:30 P.M., from October to June, at the Pittsburgh Academy of Medicine, 322 N. Craig St.

ROCKY MOUNTAIN STATES

Rocky Mountain Radiological Society (North Dakota, South Dakota, Nebraska, Kansas, Texas, Wyoming, Montana, Colorado, Idaho, Utah, New Mexico).—*Secretary,* A. M. Popma, M.D., 220 North First St., Boise, Idaho.

SOUTH CAROLINA

South Carolina X-ray Society.—Secretary-Treasurer, Robert B. Taft, M.D., 103 Rutledge Ave., Charleston. Meeting in Charleston on first Thursday in November, also at time and place of South Carolina State Medical Association.

TENNESSEE

Memphis Roentgen Club.—Chairmanship rotates monthly in alphabetical order. Meetings second Tuesday of each month at University Center.

Tennessee Radiological Society.—Secretary-Treasurer, J. Marsh Frère, M.D., 707 Walnut St., Chattanooga. Meeting annually with State Medical Society in April.

TEXAS

Texas Radiological Society.—Secretary-Treasurer, Herman Klapproth M.D., Sherman.

VIRGINIA

Virginia Radiological Society.—Secretary E. Latané Flanagan, M.D., 215 Medical Arts Bldg., Richmond.

WASHINGTON

Washington State Radiological Society.—Secretary-Treasurer, Thomas Carlile, M.D., 1115 Terry Ave., Seattle. Meetings fourth Monday of each month, October through May, at College Club, Seattle.

WISCONSIN

Milwaukee Roentgen Ray Society.—Secretary-Treasurer, C. A. H. Fortier, M.D., 231 W. Wisconsin Ave., Milwaukee. Meets monthly on second Monday at the University Club.

Radiological Section of the Wisconsin State Medical Society.—Secretary, Russell F. Wilson, M.D., Beloit Municipal Hospital, Beloit. Two-day annual meeting in May and one day in connection with annual meeting of State Medical Society, in September.

University of Wisconsin Radiological Conference.—Secretary, E. A. Pohle, M.D., 1300 University Ave., Madison, Wis. Meets every Thursday from 4 to 5 P.M., Room 301, Service Memorial Institute.

CANADA

Canadian Association of Radiologists.—Honorary Secretary-Treasurer, A. D. Irvine, M.D., 540 Tegler Bldg., Edmonton, Alberta.

La Société Canadienne-Française d'Eléctrologie et de Radiologie Médicales.—General Secretary, Origène Dufresne, M.D., Institut du Radium, Montreal. Meetings are held the third Saturday of each month, generally at the Radium Institute, 4120 East Ontario Street, Montreal; sometimes, at homes of members.

CUBA

Sociedad de Radiología y Fisioterapia de Cuba.—Offices in Hospital Mercedes, Havana. Meetings are held monthly.

ABSTRACTS OF CURRENT LITERATURE

ROENTGEN DIAGNOSIS

The Head and Neck

The Chest

The Digestive Tract

The Biliary Tract

Retroperitoneal Tumors

The Diaphragm

The Skeletal System

Gynecology and Obstetrics

The Genito-Urinary Tract

Sinus Tracts and Fistulae

RADIOTHERAPY

Malignant Neoplasms

Non-Neoplastic Disease

RADIATION EFFECTS

ROENTGEN DIAGNOSIS

THE HEAD AND NECK

Intracranial Dermoid and Epidermoid Tumors. John Martin and Loyal Davis. Arch. Neurol. & Psychiat. **49:** 56–70, January 1943.

Intracranial dermoid and epidermoid tumors are rare. They may become manifest at any age and show no particular relationship to sex, trauma, or other incidents in the medical history. They are congenital in origin, epidermoids consisting of epidermal cells in various stages of disintegration together with variable proportions of crystalline cholesterol, while the contents of dermoids represent part or all of the derivatives of the ectoderm. The terms "epidermoid" and "cholesteatoma" are often used interchangeably, but to avoid confusion, only products of chronic infection should be designated as "cholesteatoma."

Dermoid and epidermoid tumors are benign and are usually amenable to operative treatment. The dermoid occurs at many intracranial sites, but is frequently attached to the dura mater, is commonly seen in the mid line, and often lies below the tentorium cerebelli. The epidermoid is practically always located in the cerebellopontine angle.

Roentgenograms frequently reveal local erosion of the skull with an area of sclerotic bone immediately surrounding the eroded area, and flecks of calcium within it. Such changes may be produced by other types of intracranial tumors, however. Dermoid and epidermoid tumors may produce no changes in the skull or only those due to generalized increase of intracranial pressure.

The authors report 5 cases—4 dermoids and an epidermoid—taken from a series of over 700 verified intracranial tumors. In most large series of verified tumors the epidermoids are four times as common as dermoids. All 5 patients were successfully operated upon.

DEPARTMENT OF ROENTGENOLOGY,
UNIVERSITY OF MICHIGAN (C. H. B.)

Hypertelorism with Facies Bovinia. A. C. Callister. Rocky Mountain M. J. **40:** 36–40, January 1943.

Berliner and Gartner (Arch. Ophth. **24:** 691–697, 1940) define hypertelorism as "a congenital anomaly of the skull and face characterized by a wide separation of the orbits causing the eyes to be too far apart. The large interpupillary distance is exaggerated by a divergent squint in most cases."

The author reviews the literature and reports 2 cases in girls 8 and 10 years of age. In the younger patient the hypertelorism was accompanied by an enlargement of the frontal bosses, giving a rather strikingly bovine character to the facies. There was no nasal ridge and the nostrils opened high and to the side. Roentgenologically, the frontal bone was found to be much broader than normal and in the region of the frontal bosses there were areas of rarefaction or lack of ossification. There was no definite delineation of the ethmoidal or sphenoidal sinus regions, and delineation of the antra was questionable.

In the second case there was apparent widening of the anterior cerebral fossae together with a dipping downward in relation to the superior orbital line, accompanied by excessive lateral development of the sphenoid, maxillae, and nasal bones.

Complete case histories are presented, together with descriptions of plastic procedures undertaken in the younger child.

PERCY J. DELANO, M.D.

Platybasia: Report of a Case Treated Surgically with Improvement. R. H. Stevens. Surgery **12:** 943–951, December 1942.

Platybasia, or basilar impression, is clinically the result of the mechanical and neurological changes produced by a bulging upward of the bony structures about the foramen magnum, as if the bones of the skull in this region were softened and the skull were pushed down on an unyielding cervical spine. It has frequently been mistaken for multiple sclerosis, syringomyelia, or one of the various types of paralysis. Correct diagnosis in the early stages can probably never be made without the aid of roentgenograms. The present tendency, therefore, to x-ray all cases considered to be multiple sclerosis for a possible platybasia is a practice which should be encouraged.

Though the etiology of platybasia is still obscure, it is probably due to an anomalous development of the basiocciput and frequently, also, of the upper cervical spine. The fact that in most cases there is associated partial fusion of the spines of the upper cervical vertebrae gives credence to this theory. Rickets, cretinism, hydrocephalus, idiopathic and puerperal osteomalacia, and senile atrophy have only an incidental significance. Weight-bearing or acute trauma has initiated symptoms or caused exacerbations of symptoms in a number of reported cases including the one recorded here.

For diagnosis, Chamberlain (Yale J. Biol. & Med. **11:**487–496, 1939) originally proposed the following empirical criterion. A line is drawn on a lateral x-ray film of the skull, from the posterior end of the hard palate to the dorsal margin of the foramen magnum. If any of the cervical vertebral elements fall above this line, some degree of platybasia exists. In a personal communication Chamberlain has stated that he now considers the presence of an anomalous fusion, or failure of segmentation, at the level of the first cervical vertebra and the occipital segments of the spinal canal necessary for the diagnosis of the type of platybasia which produces neurological signs and symptoms. Since the case presented in this paper does not show these anomalies, this latter requirement would seem open to question.

A second method of diagnosis is determination of the basal angle formed by the plane of the clivus and the sphenoidal plane, which runs through the root of the nose and the center of the sella turcica. The extreme limits of the normal range, as given in the literature, are 110 and 150 degrees.

The neurological picture of platybasia is partly produced by bony encroachment on the cerebellum within the posterior fossa. There is probably, also, some angulation or an altered relation of the cerebellar peduncles. Most of the medullary symptoms are the result of a sharp backward tilting of the axis and atlas, with pressure on the cord by the odontoid process, as the anterior weight-bearing portions of these vertebrae push farther into the cranial cavity than do the posteriorly placed laminae. The clivus is markedly elevated and presses on the pons. These altered relation-

ships all contribute to impairment of the posterior cranial and upper spinal nerves.

Symptomatically, early cases, without increased intracranial pressure, and without sufficient bony change to alter the appearance of the neck, may closely simulate multiple sclerosis. Both conditions are usually manifested chiefly by cerebellar, cranial nerve, and spastic and sensory signs. Moreover, the essence of the diagnosis of multiple sclerosis, *i.e.*, remission of signs and symptoms, also occurs with platybasia.

Therapy consists of removing the bone from the posterior rim of the foramen magnum and performing a laminectomy on the upper two or three cervical vertebrae. This bone removal, though not in any way curative, relieves to a great extent the pressure on the cerebellum and posterior cranial nerves, and the angulation and constriction of the medulla at the foramen magnum. The bone has no weight-bearing function, but with the altered relations in platybasia, the posterior arch of the atlas and posterior margin of the foramen magnum may be weight-bearing. If this is the case, acceleration of the progress of the disease after operation must certainly be considered a possibility. The 8 cases from the literature in which operation has been performed are summarized in a table.

The author adds a case of his own in a man of 52 in which trauma at the age of 23 was the precipitating factor. The history showed the characteristic alternation of symptoms and remissions. Roentgen studies of the skull (July 1941) showed the base to be scaphoid in contour and the entire body of the first cervical vertebra and more than half of the second to lie above "Chamberlain's line." Operation was performed and up to fifteen weeks later, when the patient was last seen, improvement was progressive.

J. E. WHITELEATHER, M.D

Localizing Value of the Clinical, Electroencephalographic and Pneumoencephalographic Findings in Epilepsy. H. Sjaardema and M. A. Glaser. Am. J. M. Sc. **204:** 703–715, November 1942.

The relative values of the clinical study, the electroencephalogram (EEG), and the pneumoencephalogram (PEG) for localization of focal cerebral lesions in convulsive disorders were studied in 52 cases.

The EEG was more reliable in that it indicated focal epilepsy in 33 cases as against 31 cases shown by clinical methods, and only 9 by air studies. The EEG was normal in only 2 cases; in 20 of 32 cases it showed seizure patterns. A greater number might have been demonstrated had it been possible to hyperventilate each case.

Eighteen of 24 cases of idiopathic epilepsy and 14 of 28 cases of symptomatic epilepsy had seizure patterns. In addition, such other abnormalities as increased beta voltage, unequal alpha, delta patterns, and increased beta voltage with delta patterns were demonstrated.

From a clinical standpoint 31 patients had focal, and 21 had generalized epilepsy. The EEG demonstrated areas of abnormal activity in all but one case each of focal and general epilepsy. The EEG was the only evidence that areas of abnormal activity existed in the brains of those patients with general epilepsy. The abnormalities, as determined by the three tests, were more frequently located in the frontal lobes.

The EEG lateralized the lesion in each case showing ventricular shift by PEG. Specific EEG abnormalities were not found in patients with increased or decreased cortical air or unequal ventricles. Severe hydrocephalus showed increased beta voltage combined with delta.

[A short explanatory note as to the significance of the various wave abnormalities would have been extremely useful. As it is, only investigators in this particular field would thoroughly understand the article. B. C.]

BENJAMIN COPLEMAN, M.D.

THE CHEST

Development of Tuberculosis in the Apparently Healthy Adult. A. B. Robins. Am. Rev. Tuberc. **47:** 1–10, January 1943.

The death rate from tuberculosis among the colored population of New York City in 1938 was more than six times that of the white population. The assumption has been made on the basis of such mortality standards that the prevalence and incidence of tuberculosis are correspondingly higher in the Negro group. In an attempt to throw further light on the problem, it was decided to study the incidence of tuberculosis in the white and Negro population in the Harlem area of New York.

A survey of home relief recipients in 1937 had revealed approximately 40,000 persons whose x-ray films showed no evidence of pulmonary tuberculosis. An attempt was made to have these persons return in 1938 for an additional x-ray examination, and 8,731 persons, or a little better than 20 per cent, responded. Twenty-five cases of tuberculosis were found in this group, 21 in Negroes, 3 in Puerto Ricans, and 1 in a white person. One patient had an idiopathic pleurisy with effusion. Of the remaining 24, 18 were considered to have exudative or caseopneumonic lesions, and 6 were listed as being of productive type. In 18 patients the lesion was in the right lung, in 5 it was in the left lung, and in 1 case both lungs were involved. This tendency for tuberculosis to develop in the right lung was not influenced by the age of the patient but seems to have been markedly influenced by the sex, since 11 of the 13 cases in females were right-sided whereas 7 males had lesions in the right lung, 3 in the left, and one on both sides. Only 9 patients gave a history of symptoms prior to the discovery of the disease by x-ray.

Comparison of these findings with the studies of others would indicate that an annual incidence rate of 2.4 per thousand among the home relief recipients of Harlem, 86.2 per cent of whom were Negroes, is not very much higher than the rates observed in other groups. Thus Fellows has reported incidence rates varying from 2.23 to 2.69 per thousand per year among home office employees of the Metropolitan Life Insurance Company, a group composed predominantly of young white females. Since the mortality rate in Negroes over twenty years of age is three to ten times that of white persons of the same age, no correlation between incidence and mortality could be demonstrated. It is concluded, therefore, that the annual incidence rate of tuberculosis is not determined by the mortality rate; that incidence and mortality are independent of each other. L. W. PAUL, M.D.

Problem of Unsuspected Tuberculosis in Pregnancy. Incidence by Roentgenologic Techniques Compared with Incidence of Unsuspected Syphilis. C. W. Eisele, W. B. Tucker, R. W. Vines, and J. L. Batty. Am. J. Obst. & Gynec. **44:** 183–196, August 1942.

Because of the seriousness of tuberculosis in the pregnant woman and the inadequacy of physical examination in detection of the disease in its early stages, fluoroscopy of the chest was made available in 1932 to patients attending the prenatal clinic of the Chicago Lying-in Hospital. During the three succeeding years 64 per cent of the clinic patients, a total of 4,040, were examined fluoroscopically with the result that unsuspected but clinically important tuberculosis was discovered in 1.06 per cent. This series is the subject of an earlier report (Eisele and Mason: Am. J. Obst. & Gynec. **36:** 387–392, 1938). More recently fluoroscopy has become a feature of prenatal care in all cases. All patients showing definite or suspected lesions are referred for stereoscopic roentgenography.

Between April 1, 1937, and July 1, 1941, 6,928 women were examined. All of this group were of the white race and their economic status was such that most of them paid for at least part of their obstetrical care and hospital fees. The average age was 25.8 years with a standard deviation of 5.5 years. The average duration of pregnancy at the time the patient presented herself for examination was 4.53 months.

Active tuberculous disease and inactive disease in which reactivation during pregnancy or the puerperium is a definite menace are designated as clinically important. The percentage of such cases discovered in this second series was not greatly different from that of the earlier period, being 0.96 per cent.

Comparing their series with a series of cases from several hospitals and maternity centers where case-finding programs were not employed, the authors find that their incidence of clinically important disease, approximately 1 per cent, as ascertained fluoroscopically, is about 15 times greater than the incidence as determined without the aid of fluoroscopy, while the incidence of active lesions is about 10 times greater. "It is therefore a fair inference," they say, "that 90 per cent of all active tuberculosis is missed by not employing some effective case-finding program." They believe that in the hands of well trained personnel, fluoroscopy followed by roentgenography in suspected cases is an accurate and efficient method.

The authors record the incidence of unsuspected syphilis in the same group of women which they examined for tuberculosis and point out the striking decrease since the passage of the Illinois hygienic marriage law. Routine chest examinations they believe should rank with routine Wassermann tests in pregnant women. While tuberculosis has moved from first to seventh place as a cause of death in the general population, for young women of the childbearing age it still holds first place, accounting for 20 per cent of all deaths. In the light of these facts, a roentgenologic case-finding program becomes an essential part of prenatal care.

Chronic Miliary Tuberculosis: Report of a Case. E. J. Welch. New England J. Med. **227:** 1025–1029. Dec. 31, 1942.

Over 120 cases of chronic miliary tuberculosis have been reported. Persons of all ages are affected but most cases occur in the second, third, and fourth decades. The sex distribution is about equal. The onset is insidious, with cough, expectoration, dyspnea, loss of weight, weakness, and often evidence of extrapulmonary tuberculosis.

The roentgen findings are bilateral total involvement of the lung fields with small soft, ill-defined lesions indistinguishable from acute miliary tuberculosis. In about half the cases a positive bacteriologic diagnosis can be made; 15 to 20 per cent have a positive histologic diagnosis; 10 per cent are diagnosed at necropsy, and the remainder on the clinical findings and course.

The duration of the disease is from six months to eight years, with an average of two years. Tuberculous meningitis and acute generalized tuberculosis are the common causes of death. At necropsy the lungs show numerous evenly distributed, tiny gray or white fibrous miliary foci, usually a few millimeters in diameter. They are characterized by a large amount of fibrous tissue and scant cellular reaction.

Differentiation from Boeck's sarcoid is difficult even at necropsy. Generalized carcinomatosis is differentiated by finding the primary focus and biopsy of nodes; pneumoconiosis by the history of dust exposure. In pulmonary congestion the heart is usually abnormal, the hilar shadows are enlarged, and the greatest change is at the bases.

A complete case report is presented.

JOHN B. MCANENY, M.D.

Pleural Effusions in Pulmonary Tuberculosis: Clinicopathological Study. B. Gordon, R. Charr, and J. W. Savacool. Am. Rev. Tuberc. **47:** 35–40, January 1943.

The authors report the results of a clinicopathological study of 80 selected cases of pleural effusion occurring in pulmonary tuberculosis; in 35 cases postmortem material was available and in these the lungs were injected with a radiopaque substance and x-ray films were used for determining the location and character of the blood vessels. In 20 of the necropsied cases, the fluid was non-purulent, but tubercle bacilli were found in all, either in the cultures or in the sediment examined microscopically. The greatest number of cases of pleural effusion were directly associated with extension of subpleural tuberculous lesions. The tubercles located in the anterior part of the lung showed a definite tendency to rupture, probably due to the greater thoracic movements in the anterior chest. The more acute the tuberculous process, the more frequently was effusion a complication. With the more chronic and proliferative lesions effusion occurred less often. There was no instance of fluid developing in cases of pneumoconiosis complicated by tuberculosis, the pulmonary fibrosis possibly holding the tuberculous process in abeyance. The age of the patient had no definite bearing on the occurrence of effusion.

The outstanding effect of pleural effusion upon the lung was a diffuse fibrosis of the pulmonary parenchyma without necessarily any arrest of the process of caseation. In treatment, repeated aspirations brought about satisfactory results in the serous, serofibrinous, and hemorrhagic effusions, and in some cases of pure tuberculous empyema. Sulfadiazine was found to be of value in controlling superimposed pyogenic infection of the fluid, and quinine urea hydrochloride used as a

sclerosing agent aided in obliterating residual pleural spaces and pleurocutaneous sinuses.

L. W. PAUL, M.D.

Abscess of the Lung. R. M. Janes. Canad. M. A. J. **47:** 540–545, December 1942.

This is a report of 106 cases of lung abscess seen in Toronto General Hospital from 1933 to 1940. Etiological factors in these cases were aspiration (following tonsillectomy, extraction of teeth, other upper respiratory tract operations, and general anesthesia administered for general surgical procedures) in 30 per cent of cases and pneumonia in 35 per cent; 22 per cent were classed as idiopathic; 10 per cent were due to embolism (septic 5 cases, sterile 6 cases), 1 per cent to trauma, and 2 per cent to perforation of an adjacent lesion. Report of location is based on 89 cases in which this seemed fairly certain: right upper lobe 34 per cent; right lower lobe 29 per cent; right middle lobe 2 per cent; left upper lobe 14 per cent; left lower lobe 21 per cent.

A bit of septic material lodging in a bronchus results first in atelectasis of the small segment of lung supplied and, when the organisms gain a foothold, in thrombosis of the vessels, thus explaining the frequent finding of masses of necrotic material in these abscesses.

The tendency is for primary abscesses of the lung to be single. Secondary abscesses may occur as a result of aspiration of material from an abscess into bronchi of the same or other pulmonary segments. Each abscess contains more than one type of bacteria. Bacteria found in a series of cases in order of their frequency are: S. viridans, Staphylococcus, M. pharyngis siccus, S. haemolyticus, pneumococcus, fusiform bacilli and spirochetes, unidentified M. catarrhalis, anaerobic streptococcus, non-hemolytic streptococcus, diphtheroid bacillus, B. pyocyaneus, Friedländer's bacillus, and B. coli.

Onset in many cases is insidious. The patient feels miserable, with malaise and loss of energy, usually mild fever, occasional chills, and pain in the chest on breathing. Cough is usually slight; it may become productive at the end of one to three weeks and purulent sputum, which may be streaked with blood, is raised. Gross hemoptysis is not uncommon. When the lesion follows an upper respiratory operation, chest pain and fever usually develop a few days after operation, and at the end of one or two weeks the patient suddenly coughs up a quantity of sputum. Cases resulting from pulmonary infarction usually give a history of sudden onset of chest pain, difficulty in breathing, and cyanosis, followed by gradually increasing fever and finally production of purulent sputum.

There may be no outstanding physical symptoms. A point of tenderness on the chest wall where the abscess is nearest the surface is a valuable sign. The most constant finding is an area of localized dullness and râles.

Roentgenologic examination of the chest is the best way of following progress of the disease. The shadow differs from ordinary pneumonias in being more localized, since changes are confined to one or another of the bronchopulmonary segments. A fluid level does not appear until some of the contents of the abscess have been evacuated into a bronchus and entry of air permitted. In a chronic lesion a cavity may not be demonstrable by ordinary exposure, due to denseness of infiltration surrounding it. Postero-anterior and lateral films are best for localization of the lesion. Bronchoscopy is important in exclusion of foreign bodies and new growths. An empyema from which a bronchial fistula has developed may be confused with abscess on history alone but is recognized by physical examination and x-ray. Infected dermoids and pulmonary cysts may simulate simple abscesses.

Early treatment is similar to that of pneumonia, including a trial of sulfonamide therapy. Bronchoscopy is of little therapeutic value. Pneumothorax is a dangerous procedure and its use should be discontinued, the most serious after effect being empyema. The only really effective treatment for those cases that do not recover promptly with medical measures is external drainage. In general, all abscesses not showing unmistakable evidence of recovery should be drained at the end of five to six weeks.

The pathological changes that occur with chronicity make spontaneous recovery and cure by drainage alone unlikely. Such cases should be treated by lobectomy, or, occasionally, by pneumonectomy.

M. L. CONNELLY, M.D.

Dust Hazard in Tremolite Talc Mining, Including Roentgenological Findings in Talc Workers. W. Siegal, Adelaide R. Smith, and L. Greenburg. Am. J. Roentgenol. **49:** 11–29, January 1943.

This is a report of an investigation of the talc industry and an examination of talc miners and mill workers in northern New York State. Talc fibrosis as an occupational disease has received attention in this country only within the past ten years. Clinical studies have tended to indicate that talc dust is capable of producing injurious pulmonary changes. The authors summarize 5 fatal cases which originally drew the attention of the Division of Industrial Hygiene to disability resulting from exposure to talc dust.

The free silica content of commercial talc as found in industrial use is very low. In six samples from two mines the amount was 1 per cent or less. The microscopic appearance of the dust differs from that of asbestos in that asbestos fibers tend to be curved and tendril-like in form, whereas those of talc appear straighter and more needle-like. Talc fibers are also much shorter than those of asbestos.

In recording pulmonary fibrosis among talc workers, slight or even moderate degrees of fibrosis were disregarded, and only those cases were included in which a marked degree of this condition was present. Fibrosis was found in 32 of 221 men examined. Eighteen of these men had not worked in any other dusty industry. No cases occurred in workers with less than ten years' exposure. Fibrosis was relatively more prevalent among millers than miners.

All 18 men in whom the fibrosis could be attributed solely to talc dust showed limited chest expansion. Ten complained of dyspnea, 7 of chronic cough, 3 of pain in the chest, 5 of fatigue. None was overweight; on the contrary, they tended to present an undernourished and drawn appearance.

The type of fibrosis seen in the roentgenograms is fine and diffuse, producing in many cases an appearance of soft haziness to which the term "ground glass," used in describing certain cases of asbestosis, can well be applied. In some cases there is, in addition, a distinctly granular appearance, and in some nodulation. The changes are more severe on the right side. Clinically significant tuberculosis was seen in 5 of the

group of 221 talc workers examined; 3 of these cases were among the 18 cases of fibrosis in men exposed only to talc. In 6.3 per cent of the cases examined talc plaques were seen on the visceral pleura, including the region of the diaphragm, and occasionally the pericardium. These deposits occurred independently of other lung lesions and could not be correlated with any particular signs or symptoms.

Microscopic study has shown that tremolite talc dust is largely fibrous in character, and it may well be that this particular physical characteristic is responsible for the pathology of the tremolite talc fibrosis. The possibility of action analogous to that which occurs in asbestosis is suggested. The authors were impressed by the resemblance of the two conditions in the roentgen picture. In both the disability tends to be greater than one would expect from the severity of the lesion as seen on the film.

The authors conclude that their study clearly indicates that the dust encountered in the tremolite talc industry is of an injurious, fibrosis-producing type which requires control if disabling occupational disease is to be prevented. Moreover, although the number of cases here presented is small, suggestive evidence has been found that exposure to tremolite talc dust is associated with increased susceptibility to tuberculosis.

CLARENCE E. WEAVER, M.D.

Virus Pneumonia: Roentgenographic Characterization of Recent Virus Pneumonitis with Bronchopneumonia. A. E. Seeds and M. L. Mazer. Am. J. Roentgenol. **49:** 30–38, January 1943.

From a study of 221 cases of non-lobar (non-pneumococcus) pneumonia, the authors feel, though the roentgenographic peculiarities of this syndrome follow the non-lobular, non-segmental, and inconstant distribution pattern previously described by many authors, that this pattern is a more or less orderly one both as to location and as to progressive chronological development, even of the various "units" in the cases in which they are multiple. They present their idea of these findings in the following form:

"1. An infiltrative process at the onset.
  "A. First progressively peribronchial from the hilus and then irregularly interbronchial; earlier in the more proximal portion.
  "B. Customarily clearly definable as to limits in spite of its disregard for segmental or lobar structural limits, usually involving more than one segment and frequently parts of more than one lobe
"2. Quickly accompanied by a 'cotton-wool' appearance of multiple areas of partial or semiconsolidation.
  "A. This is scattered through the area of infiltration; usually distributed in a radial progression also.
  "B. Frequently subsequently (six to twenty-four hours) coalescing.
  "C. Occasionally eventually (twenty-four to forty-eight hours) filling approximately a whole lobe to simulate lobar pneumonia but, so far as we have seen, always managing to present a striated infiltrative type background rather than a pure homogenicity.
  "D. Usually establishing a fixed distribution for any one area in two to three days, which afterwards behaves as a 'unit.'
"3. Resolution or absorption begins.
  "A. By generalized and uniform progressive (three to five days) loss of density throughout the 'unit.'
  "B. The development of an appearance of 'wire-grass' infiltration or 'pseudo-fibrosis' (suggesting a relatively simple reverse in the developing process).
  "C. Eventual progressive complete clearing of this process in five to fourteen days, usually five to eight days in cases of single 'units.'
"4. Occasional development of multiple 'units' with:
  "A. Subsequent definite dates of onset and individual chronology.
  "B. Rarely, involving nearly all visible parts of lung.
  "C. Usually no one unit disturbing the approximate pre-arranged chronology of any forestarted unit.
"5. Occurring quite typically in children.
  "A. We recorded only one typical case under six months, but many both under and over two years."

CLARENCE E. WEAVER, M.D.

An Acute Respiratory Infection Resembling So-Called Acute Pneumonitis: Report of 40 Cases. L. B. Duggan and W. L. Powers. J. Lab. & Clin. Med. **28:** 524–530, January 1943.

This is a report of 40 cases of acute upper respiratory infection studied in the summer months of 1941 at a United States Naval Hospital. The patients ranged from seventeen to twenty-six years of age.

The infection was characterized by an insidious onset with minimal respiratory and mild constitutional symptoms. There was no evidence to indicate that lack of physical fitness, previous upper respiratory infections, abnormal exposure, or climatic conditions were predisposing factors. No definite abnormal physical signs were observed and the leukocyte count was normal or only slightly elevated. Headache, backache, leg pains, unproductive cough, and fever (100 to 102°) were common.

The diagnosis was usually made on the third to the fifth day, when a roentgenogram was made of the chest. This often showed a small irregular or rounded area of soft to moderate homogeneous density in the central portion with borders shading into the normal lung. The lesions were not extensive, particularly those extending from the lower border of the hilus and those in the costophrenic angle. Multiple successive roentgenograms in several cases demonstrated that as the disease progressed the density increased, became more sharply defined, and frequently extended. Resolution followed the course of other types of pneumonia, the density gradually diminishing and becoming mottled and linear in type. In approximately three-fourths of the cases the involvement extended from the lower hilar areas into the cardiophrenic angle or appeared at the base of the lung.

Physical signs were manifested by râles at the base of the lung. The râles appeared from the fourth to

the eighth day and were medium, moist, and usually persisted from one to two weeks. Approximately one-half the patients were hospitalized for a period of three weeks.

The treatment was largely symptomatic, with sedatives for cough and restlessness. Sulfathiazole was administered in 12 cases but did not seem to be beneficial. DONALD R. LAING, M.D.

Bronchomoniliasis. W. A. Farrell. Canad. M. A. J. **48:** 28–30, January 1943.

Pneumonomycosis is reported only rarely in Canada, but because of the difficulty of diagnosis, the author believes it may often be overlooked. The types of fungi most often found in the lungs are Blastomyces, Actinomyces, Penicillium, Monilia, Aspergillus, Mucor, Torula, and Coccidioides.

Bronchomoniliasis is a bronchopulmonary mycosis caused by Monilia. This is a yeast-like fungus found in decaying woods and leaves. It acts physiologically like a true yeast, in that it ferments sugars and produces gas. Morphologically it differs from true yeast in having a vegetative body consisting of a collection of fine filaments and reproducing by free-borne spores.

Fungous infection of the lungs is not easily diagnosed but should be suspected in the presence of pulmonary disease that does not readily fit into one of the accepted diagnostic categories. The disease is most often mistaken for tuberculosis, and several points are mentioned which may be useful in differentiation. Constitutional symptoms are less severe in fungous infections; the progress is slow and marked by the development of extreme fibrosis. The lesions are frequently in the hila or lower lobes and seldom in the apices, while tuberculous lesions usually involve one or both upper lobes. Quinine sulfate is suggested for treatment.

A case is reported in a miner who a year earlier had had a routine roentgen chest examination with negative results. He complained of loss of weight, an increasing sense of fatigue, and shortness of breath on exertion. A chest film (September 1940) showed a diffuse parenchymatous infiltration of both lungs, heaviest in the mid-zones, where it approached consolidation. Laboratory examinations were consistently negative for tuberculosis, and at first no spirochetes or fungi were found in the sputum. Nine months after the onset of chest symptoms and one month after admission to the sanatorium, a yeast-like fungus was isolated from sputum cultures which fermented glucose, levulose, arabinose, and maltose. Acid was produced on milk and milk was coagulated. By its biological characteristics the organism was identified as Monilia. A second report, a month later, was identical, thus establishing the diagnosis of bronchomoniliasis. The patient was given quinine sulfate (gr. v, b.i.d., per os) beginning Dec. 28, 1940, and subsequent x-ray examination showed prompt improvement. By March there were no physical signs in the chest and the patient was carrying on full industrial employment.

M. L. CONNELLY, M.D.

Pulmonic Contusion in the Intact Thorax: Report of a Case. Joseph D. Brown and Paul S. Friedman. Pennsylvania M. J. **46:** 352–354, January 1943.

Traumatic intrapulmonic hemorrhage without x-ray evidence of injury to the thoracic cage, although not uncommon in civil life, is more usual during military activity. It may be the result of injury to the thoracic cage or the effect of an explosion. In the latter event it is known as a blast injury.

The mechanism by which the damage to the lungs occurs is different in the two types of injury. In the traumatic injury the blow causes a rise in the intrapulmonic pressure due to entrapped alveolar air, with a consequent rupture of the alveoli. The young are especially susceptible, as the thorax is readily compressible. In blast injuries it is thought that the damage to the lungs is due to impact of the compression wave which follows an explosion, operating directly through the air passages.

The posterior median portions of the lower lobes are most commonly involved in both types of injury. In the more severe cases there may be a break in the continuity of the lung or the lung may even be pulverized. Accompanying rupture of the liver and spleen may also occur.

[Blast effects in warfare were the subject of an editorial in the June 1943 issue of RADIOLOGY.]

JOSEPH T. DANZER, M.D.

THE DIGESTIVE TRACT

Intestinal Obstruction in the Newborn. J. W. Duckett. Ann. Surg. **116:** 321–333, September 1942.

Congenital intestinal obstruction, from the anatomic standpoint, may be intrinsic or extrinsic. The intrinsic type, which is more frequent, results from incomplete vacuolization of the central mass of epithelium in the primitive gut during early fetal development, with the result that one or more septa remain to block the lumen or whole sections of the intestine may be represented by solid fibrous cords. Extrinsic obstruction results from incomplete rotation of the colon associated with abnormally situated bands of peritoneum which frequently impinge upon the small bowel, usually the lower half of the duodenum. The clinical picture is the same in both types.

Congenital obstruction can often be diagnosed from the history alone. Persistent projectile vomiting of bile-stained fluid soon after birth almost invariably means obstruction of the intestine, in the absence of intracranial injury or unusual infection. Roentgenologic studies are of definite diagnostic value. Plain films of the abdomen outline the obstructed stomach and small bowel and are usually adequate. Barium is not recommended unless absolutely necessary because of the possibility of aspiration after vomiting and the possible interference with the subsequent operative procedures by collected masses of the contrast medium.

The survival rate of infants with complete obstruction depends upon early diagnosis and immediate surgical repair of the defect, as well as close co-ordination of medical and surgical care. In intrinsic obstruction the best chance of a favorable outcome is offered by performance of a primary anastomosis about the site or sites of obstruction. In extrinsic obstruction Ladd has demonstrated that the most satisfactory results are to be obtained by releasing the peritoneal band lying across the duodenum and reducing the volvulus of the small intestine often associated with this lesion.

Six cases are reported, five of which were of the in-

trinsic type There were 3 cases of jejunal atresia. One of these patients died before operation could be attempted. The other two were operated upon unsuccessfully and died within 17 days after operation. The defects in these children were so extensive that physiologic function could not be restored after operation. The remaining two cases of the intrinsic type were of duodenal stenosis; both patients survived operation and were developing normally at the time of the report. The one patient with extrinsic obstruction also survived and is now apparently normal. The Ladd operative technic was used in this case.

P. C. BRIEDE, M.D.

Multiple Atresia of the Small Intestine: Case Report. D. M. Glover, Simmons Smith, and Oliver Eitzen. Ann. Surg. **116:** 337–341, September 1942.

This article is a case presentation of acute intestinal obstruction in a newborn infant resulting from multiple (eight) separate and complete points of occlusion of the small intestine.

The infant, born two months prematurely, was admitted to the hospital two days after birth. She had been unable to take milk or water and had vomited a small amount of bile-stained fluid. There had been no stools or meconium. In the hospital after each feeding bile-stained fluid was vomited and peristaltic waves were observed passing from left to right in the epigastric region. Roentgenologic studies showed the stomach and duodenum greatly distended with gas and an absence of gas in the remainder of the small bowel. Barium by mouth would not pass beyond the second portion of the duodenum.

At operation, atresia at the junction of the jejunum and duodenum was discovered and an end-to-side anastomosis was made with the jejunum. The patient lived for 36 hours after operation. Postmortem eight separate and complete occlusions of the small intestine were found.

In reviewing the literature the authors were able to find fewer than 100 cases of this type. Congenital obstruction of the bowel is believed to occur about once in 20,000 births, and in about 15 per cent of these the atresia is multiple. P. C. BRIEDE, M.D.

Peptic Ulcer in the Aged: A Clinical and Postmortem Study. J. Meyer and O. Saphir. Am. J. Digest. Dis. **10:** 28–30, January 1943.

Acute peptic ulcer, while not common in the aged, does occur, and is often an unrecognized complication of other diseases. It may cause death by hemorrhage or perforation.

A study of 16 cases was made in which at autopsy single or multiple duodenal or gastric ulcers were found. Seven of the 16 patients had Wangensteen tubes inserted into the stomach for varying periods, and the authors suggested the possibility that pressure from these tubes may be a factor in producing ulcers. They do not believe that increased hydrochloric acid in the stomach is a cause of the acute ulcers in the aged, but regard it as more likely that sclerosis of the arteries brings about local necrosis which favors ulcer development. JOSEPH T. DANZER, M.D.

Gallstone Ileus. P. R. Hinchey. Arch. Surg. **46:** 9–26, January 1943.

Thirteen cases of bowel obstruction due to impacted gallstones are reviewed. According to the literature 1 to 2 per cent of obstructions are due to this cause. In this series the percentage was 6. The average reported mortality is 50 per cent. One reason for this is the advanced age of the patients; the average for this and also for some other series was 66 years. The reported sex ratio is 5 females to 1 male; there was only 1 man among the author's patients. The mortality for the series was 46 per cent.

The fistula through which the stones are discharged is thought to be formed as a result of common duct obstruction. There are 5 stages in the development of the condition: (1) antecedent acute cholecystitis; (2) chronic cholelithiasis; (3) passage of gallstones through a fistula into the intestine; (4) recurrent bouts of intestinal colic; (5) the final ileus due to the impacted stone. The cause of impaction is the progressive decrease in the caliber of the bowel from duodenum to ileum; it is for this reason that the ileum is the usual site of obstruction.

Stones may lodge in the bowel, even for years, and increase in size if certain types of medication are used. Stones less than 2.5 cm. in diameter are usually passed. The largest recorded stone successfully removed weighed 5 ounces (Turner: Brit. J. Surg. **20:** 26–33, 1932).

The symptoms are those of an intestinal obstruction, but are seldom clean-cut. Rarely a peritonitis from perforation may complicate the picture. The correct diagnosis is rarely made preoperatively, but the x-ray may make this possible. The demonstration of stones in the lower bowel region, or of a cholecystenteric fistula plus an obstruction, or of an obstruction whose level progresses distally in the bowel, is suggestive. Operation, usually an enterotomy, is the treatment of choice; enterostomy is seldom necessary. Closure of the fistula to prevent an ascending cholangitis is desirable if the patient's condition permits.

LEWIS G. JACOBS, M.D.

THE BILIARY TRACT

Operative Cholangiography. R. B. Bettman, J. Tannenbaum, and R. A. Arens. Surgery **13:** 131–135, January 1943.

One of the chief problems of gallbladder surgery has to do with exploration of the common duct. If there are no stones in the duct, it is best to leave it alone; if stones are present, it is essential to remove all of them. Every surgeon of experience knows, however, the difficulty of determining whether stones are present and the even greater difficulty of knowing whether or not all stones have been removed. Experience has shown again and again that the ability to pass a probe through the common duct into the duodenum is not an absolute sign that a stone is not present. In a dilated common duct a stone of large size may lie in the lumen and not come in contact with the probe at all. Even when the duodenum is mobilized the stone may not be palpable with or without a probe in the duct.

In view of these difficulties, the authors make use of immediate cholangiography whenever there is the slightest possibility that a common duct stone may be present.

A portable spark- and shock-proof x-ray machine is used in the operating room. A small Bucky diaphragm containing a tunnel for the plate is placed on the operating table so that its center will roughly underlie

the common duct. The rest of the table is leveled with pads. After the gallbladder and ducts have been exposed, the common duct is palpated, as usual, with the index finger in the foramen of Winslow. If a cholangiogram is indicated, the cystic duct is isolated as if for ligation and a ligature passed around it. Through a small slit a ureteral catheter is threaded into the cystic duct and through it into the common duct. The ligature is then tied with a single knot tightly enough to hold the catheter in place, but not tightly enough to constrict the duct. From 5 to 20 c.c. of a sterile solution of skiodan and acacia are injected through the catheter into the duct. If the patient is having a general anesthesia, a temporary apnea is produced by means of a high oxygen concentration. If the operation is being done under spinal anesthesia the patient simply holds his breath. The roentgenogram is taken and immediately developed in a neighboring darkroom with high-speed developers and fixatives.

If the cystic duct is obstructed, the skiodan and acacia are injected directly into the common duct with a syringe and fairly short pointed needle. If the common duct is greatly distended it will frequently be necessary to aspirate much of the contained bile before making the injection.

There have been no ill results from this procedure, and the authors believe that the slight prolongation of the operation is amply justified.

J. E. WHITELEATHER, M.D.

Note on Amoebic Hepatitis. J. A. Ross. Brit. J. Radiol. **16:** 30, January 1943.

Though amebic hepatitis is rare in British civilian practice, it is relatively common in men who have served overseas. The patients may complain of only slight malaise and tenderness in the right hypochondrium. There is a low grade fever. Often there is no diarrhea, though a history of this is invariably obtained on close inquiry.

On screen examination the diaphragm is seen to be raised and to have a limited excursion. The raised dome may or may not show irregularities due to localized liver "humps." After a course of treatment, the diaphragm regains its normal position and motion.

The excursion of the diaphragm may be recorded on films by the double exposure method.

Radiologists should be on the watch for amebic hepatitis. A raised diaphragm, with diminished excursion, without other explanation, is sufficient evidence to create a suspicion of the disease.

SYDNEY J. HAWLEY, M.D.

RETROPERITONEAL TUMORS

Retroperitoneal Dermoid (Report of a Case). John J. Bottone. Urol. & Cutan. Rev. **47:** 26–28, January 1943.

Retroperitoneal dermoids are rare. Campbell in 1933 found 5 cases reported in the literature and added one case. Another is reported here by Bottone.

A 52-year-old white male was admitted to the hospital complaining of back pain of six weeks' duration. A diagnosis of retroperitoneal tumor was made by means of intravenous pyelography and roentgenography with the aid of perirenal air insufflation. The left kidney was displaced laterally and slightly rotated. The calcified abdominal aorta was displaced anteriorly. Exploratory laparotomy confirmed the diagnosis. The tumor could not be removed because of its attachment to the aorta. The biopsy diagnosis was dermoid cyst.

The author discusses the theories offered for retroperitoneal tumors. Some writers believe them to originate from the embryonic germinal folds, others from the embryonal urogenital apparatus. Retroperitoneal dermoids are benign and slow-growing. Symptoms are caused by pressure on adjacent organs. The author stresses the importance of pyelography and perirenal air insufflation roentgen studies in diagnosis.

MAURICE D. SACHS, M.D.

THE DIAPHRAGM

Case of Eventration of the Diaphragm. A. J. E. Mills. Brit. M. J. **1:** 97–98, Jan. 23, 1943.

The author presents a careful account of a case of diaphragmatic eventration and makes the following comment regarding the condition. Eventration of the diaphragm occurs more often than is generally believed and the degree of disability therefrom varies considerably, so that the diagnosis is not easy. In discussing diagnosis he points out that the movement on the affected side may be either normal, diminished, or paradoxical. Various associated phenomena are referred to, as, for example, increased divergence of the costal margin from the mid-line on the side affected. Of the suggestive symptoms, hiccup had the most important position in the case reviewed. A high diaphragm alone may not be diagnostic of eventration, as very commonly a megacolon will cause considerable diaphragmatic elevation. Q. B. CORAY, M.D.

SKELETAL SYSTEM

Paravertebral Abscesses Associated with Strümpell-Marie Disease. A. Oppenheimer. J. Bone & Joint Surg. **25:** 90–96, January 1943.

This is a digest of 4 cases of paravertebral abscess formation associated with spondylitis of the Strümpell-Marie type. The course of the disease was chronic in all cases, with the abscess limited to the same region as the spondylitis. Roentgenograms demonstrated an ankylosing arthritis of the apophyseal joints at the level of the soft-tissue abscess, with ossification of the vertebral ligaments. In all 4 cases pain and other localizing signs were present for a number of years. Those abscesses from which cultures were taken showed a mixture of organisms, but no tubercle bacilli, fungi, or organisms of the typhoid group were found.

The author is of the opinion that the bone and joint involvement are secondary to the soft-tissue infection, since, if the reverse were true, one would expect to find evidence of bone destruction and sclerosis rather than the mild reaction for the long duration of the disease. Instead of necrosis of bone there was ankylosis of the apophyseal joints. The association of ossification of the vertebral ligaments with ankylosis of the apophyseal joints is pathognomonic of the Strümpell-Marie type of spondylitis.

There is some conjecture as to the relationship between the cases here recorded and cases of rarefaction of the odontoid process with dislocation, following an upper respiratory infection.

JOHN B. MCANENY, M.D.

Herniation of the Cauda Equina Following Laminectomy of the Sacrum. M. H. Herzmark. J. Bone & Joint Surg. **25:** 197–201, January 1943.

A patient with severe low-back pain was thought to have a protruding intervertebral disc and the spinal canal was examined after injection of lipiodol. No protrusion was found. The pain continued, and the sacrum was trephined to remove the lipiodol. Eventually the patient was subjected to a spinal fusion operation, at which time the cauda equina was found to be herniated through the trephine opening. It was released and returned to its normal position. The roof of the sacral defect was repaired by bone chips, and the patient made a good recovery.

The object of this report is to demonstrate that even though the roof of the sacral canal is easily removed and near the surface, the procedure is not entirely innocent and herniation of the cauda equina may occur.

JOHN B. MCANENY, M.D.

Chondrodystrophia Calcificans Congenita. G. Raap. Am. J. Roentgenol. **49:** 77–82, January 1943.

Roentgenograms of a male child aged ten months showed a mottled granular appearance in the ankles, wrists, and other joints which in contour followed that of the bony structures in normal ossification, but presented angular densifications rather than rounded densities. A deceased male twin of the patient was examined and showed exactly similar joint changes. In two other children of the same parents there was evidence of the same changes. The bony structure of the parents was normal. Repeated examinations showed the abnormal calcifications to be most marked at birth, disappearing by the age of about three years. Blood chemistry studies were negative. There was no evidence of dwarfism or cretinism. Rickets and scurvy were ruled out by the dietary history. The stippling was confined to the epiphyseal centers and was not present in the cartilage. The children were apparently normal in every other respect, living under ordinary conditions of life. In previously reported cases there have been evident contributory factors, such as developmental variants, syphilis, cretinism, or hypothyroidism. CLARENCE E. WEAVER, M.D.

Calcification in the Menisci. E. F. Cave. J. Bone & Joint Surg. **25:** 53–57, January 1943.

The purpose of this presentation is to call attention to the fact that calcification may occur in the menisci of the knee joint and be mistaken for free ossifications in the joint. This calcification has been recognized before, especially by German writers, but has received little mention in the American literature. The change in the meniscus seems to be degenerative, in the later years of life.

The diagnosis is made by roentgenograms keeping in mind that the menisci may become calcified. The roentgenogram shows abnormal calcification in the knee joint.

Two cases are reported in which the patients had knee injuries and showed calcification medially in the posterior compartments of the injured joint. Removal of the calcified meniscus afforded relief.

The importance of recognizing this condition lies in the fact that the calcification can be removed by removal of the cartilage without exploring the rest of the joint. JOHN B. MCANENY, M.D.

Syndrome Characterized by Primary Ovarian Insufficiency and Decreased Stature: Report of 11 Cases with Digression on Hormonal Control of Axillary and Pubic Hair. F. Albright, P. H. Smith, and R. Fraser. Am. J. M. Sc. **204:** 625–648, November 1942.

A syndrome is described in females which is characterized by the following features:

1. The patients are extraordinarily short, but are not dwarfs. Since there is delayed union of the epiphyses, and hence an increase in the time during which the patients grow, the defect is obviously in the rate of growth. Among the possibilities considered, the authors believe that decrease in estrin production leads to a secondary change in the adrenal cortex, which in turn results in a decreased growth rate.

2. The patients resemble pituitary dwarfs in that they have infantile mammae, uteri, and vaginae.

3. In contrast to pituitary dwarfs, these patients usually have a small amount of axillary and pubic hair. If pubic and axillary hair growth at puberty is due to some ovarian hormone, then it is difficult to see why patients with primary ovarian failure should have any such hair. It is believed that the immediate hormone which stimulates hair growth in these regions comes from the adrenal cortex.

4. In contrast to the pituitary dwarfs, these patients are usually strong and well nourished.

5. The bone age is usually retarded a few years, but in most cases the epiphyses eventually unite. In the pituitary dwarf the bone age is much more retarded and the epiphyses often never unite. As in other conditions with retarded bone age, "epiphysitis" similar to Scheuermann's disease is common.

The long bones are disproportionately shorter than the body. The moderate delay in epiphyseal closing may be associated with the fact that these patients have normal or nearly normal adrenals, while pituitary dwarfs have hypoplastic adrenals. Cases of "primary amenorrhea" with an increase of the follicle-stimulating hormone, with normal stature, may possibly be due to the onset of the menopause before puberty, failure of the epiphyses to close, and hence even slightly increased growth.

6. There is constantly present an increase in the urinary follicle-stimulating hormone, which is absent in pituitary dwarfs.

7. The "17-ketosteroid excretion" in the urine, while lower than in the normal female, is much higher than in the pituitary dwarf.

8. Estrin therapy leads to the development of normal amounts of axillary and pubic hair; in the pituitary dwarf, such therapy is fruitless.

9. The insulin tolerance shows normal hypoglycemia responsiveness as opposed to the hypoglycemia unresponsiveness in pituitary dwarfism.

10. Congenital anomalies, particularly absence or malformation of the ovaries, aortic coarctation, and webbing of the neck, are common.

11. Diffuse osteoporosis, similar to postmenopausal osteoporosis, is common, and, as in panhypopituitarism, precocious senility occurs.

This syndrome must be differentiated from menopause occurring shortly before the menarche, from panhypopituitarism, and from selective deficiency of gonadotropic anterior pituitary hormones with secondary ovarian atrophy.

Replacement therapy with estrin leads to an increase in general well-being, causes development of breasts

and an increase in the axillary and pubic hair, and probably leads to an increase in the rate of growth in those subjects whose epiphyses are still ununited.

BENJAMIN COPLEMAN, M.D.

March Fractures. H. E. Sweet and W. H. Kisner. J. Bone & Joint Surg. **25:** 188–192, January 1943.

With the increased mobilization of men for military service there is an increase in the frequency of foot trouble. Men are taken from their peace-time occupations and are subjected to long hours of walking and standing, with the result that many have foot complaints and on careful examination and follow-up study are found to have the so-called march fracture.

These fractures are believed to be due to overloading of the foot, inflammatory conditions and neurogenic influences playing a possible secondary role. The second, third, and fourth metatarsals are the bones most frequently involved. The earliest change is a hair-line separation in the cortex that may easily be overlooked or may not appear on the roentgenogram. Later callus formation develops, showing the fracture site. The patient complains of pain and disability, often without being able to determine the exact time of onset. There is usually some edema on the dorsum of the foot, which is tender to touch.

Treatment consists of application of a plaster boot for four to eight weeks, followed by physiotherapy for one or two weeks, after which the patient is returned to full military duty. JOHN B. MCANENY, M.D.

Invasion of the Bony Pelvis by Carcinoma of the Cervix Uteri as a Cause of Pathologic Central Dislocation of the Hip. J. R. Elder and N. M. Matheson. Ann. Surg. **116:** 1–5, July 1942.

In this paper the authors stress the point that in their experience the most common cause of pathologic dislocation of the hip, or protrusio acetabuli, is direct invasion of the bony pelvis by carcinoma of the cervix. This is not a well recognized fact and it has received slight attention in the literature.

Four cases are presented of late direct lateral invasion of the bony pelvis with resulting pathologic central dislocation of the hip involved. The predominating symptom was pain in the hip and leg described as "bearing down" in character. The authors attribute this to implication of the sacrococcygeal plexus or the obturator nerve by the malignant process, "though in advanced cases the lesion in the bone must make a large contribution." P. C. BRIEDE, M.D.

Fracture of the Neck of the Femur Following Irradiation for Carcinoma of the Uterus. D. C. Conzett. J. Iowa State M. Soc. **33:** 15–17, January 1943.

The author reports a case of fracture of the neck of the femur following irradiation for carcinoma of the uterus. The patient, 76 years of age, had been given intensive treatment with both radium and roentgen rays (dosage not given). Three months after completion of the treatment she complained of severe pain in the right hip. Later, because of continuance of the pain, x-ray examination was done, revealing a fracture of the neck of the femur. Axillary and abdominal metastases developed and the patient died. Autopsy showed a grade 4 carcinoma of the uterus; metastases to the right lung and axillary and paravertebral lymph nodes; a spontaneous fracture of the neck of the right femur with fibrocartilaginous union, but with no evidence of metastasis in this region.

The literature is briefly reviewed, and it is pointed out that the most common causative factor for such fractures is metastasis, but nutritional changes following irradiation must be considered. The treatment of the fracture must be individualized and may depend upon the ultimate prognosis of the neoplasm. Since most cases heal by fibrous union, only the simplest procedures need be carried out in some instances.

L. W. PAUL, M.D

Effect of Roentgen Irradiation on Epiphyseal Growth: Experimental Studies upon the Albino Rat. J. S. Barr, J. R. Lingley, and E. A. Gall. Am. J. Roentgenol. **49:** 104–115, January 1943.

In these experiments on albino rats all of the animals in a given treatment group received equal amounts of radiation, the individual group dosages ranging as follows: 665 r, 835 r, 1,000 r, 1,165 r, 1,335 r, 1,500 r, and 1,800 r. Each dose was administered at a single sitting to the right hind extremity, the field centering about the knee joint. The apparatus was so arranged that the medial surface of the thigh received the entrance dose, and the lateral aspect the exit dose. Roentgens were measured in air with a Victoreen dosimeter. The following factors were used: 200 kv. (peak), 20 ma., 24 cm. distance, 0.25 mm. Cu plus 1.0 mm. Al filtration, intensity 203 r per minute, copper half-value layer 0.75 mm. The following are the authors' conclusions:

"A group of 30-, 90-, and 180-day-old albino rats were subjected to roentgen irradiation of one knee joint and the resultant changes studied histologically and roentgenographically. The epiphyseal plate is a very radiosensitive tissue. Doses of 665 to 1,165 r produced moderately severe histological changes while doses of 1,335 to 1,800 r caused very severe injury as evidenced by disruption of the cartilage cell columns and destruction of chondrocytes. There was no evidence indicating stimulation and only inconsequential evidence of regeneration of epiphyseal cartilage. Other tissues in the treated area—skin, subcutaneous tissue, muscle, synovia, and articular cartilage—showed insignificant changes of a transitory nature. The hematopoietic elements of the bone marrow in the treatment field were diminished but this local effect seemed to be of little significance to the organism as a whole. No degenerative or traumatic changes were noted in the treated joints even after nine months' observation.

"Careful measurement of longitudinal growth of the tibia after irradiation showed that the doses used (665 to 1,800 r) all produced retardation of growth and that the retardation varied roughly proportionately to the irradiation administered. The large doses 1,335 to 1,800 r seemed to produce essentially complete arrest of growth of the treated epiphysis."

CLARENCE E. WEAVER, M.D.

GYNECOLOGY AND OBSTETRICS

Comparative Measurements of the Female Pelvis. K. Dickinson, and I. M. Procter. Am. J. Obst. & Gynec. **44:** 585–591, October 1942.

There are four methods by which the diameters of the pelvis may be measured. (1) The diagonal conjugate may be obtained and the true conjugate estimated

from it by subtracting 1.5 to 2 cm. (2) X-rays may be directed into the pelvic inlet by the technic of Thoms, Torpin, and others. (3) X-rays may be directed lateral to the pelvic inlet by the technic of Thoms, Jacobs, and others. Finally (4), the patient may be operated upon and the true conjugate measured directly.

The authors have undertaken to compare measurements of the anteroposterior diameters of the pelvis obtained by these methods. First, the anteroposterior diameter measured by one x-ray technic is checked for accuracy against the same diameter obtained by the second x-ray technic. Second, the anteroposterior diameter of the pelvis obtained by x-ray is checked for accuracy against the same diameter measured at the time of operation. Third, the anteroposterior diameter obtained by x-ray is compared with the diagonal conjugate. Fourth, the anteroposterior diameter measured at the time of operation is compared with the diagonal conjugate.

Two hundred and twenty-nine persons were studied by both the anteroposterior and lateral x-ray technics. In 83 per cent of these the anteroposterior diameter was found to be essentially the same by both procedures. In 44 cases the measurements were made under direct vision at the time of operation. Comparison of these with anteroposterior and lateral x-ray measurements showed agreement in only 40 and 41 per cent, respectively. This is explained by the fact that the x-ray measurements are bone to bone while the direct measurements are from soft tissue to soft tissue. Estimate of the true conjugate by subtracting 1.5 to 2 cm. from the diagonal conjugate was found to give a less reliable measure than the unmodified diagonal conjugate.

In the series of 300 women studied, the gynecoid pelvis was the predominant type; mixed forms were next in frequency.

Review of the Caldwell-Moloy Method of Roentgen Pelvic Mensuration with a Correlation of New Technical Procedures. R. Taylor. Am. J. Obst. & Gynec. **44:** 348–350, August 1942.

The Caldwell-Moloy method of roentgen study of the osseous structures of the maternal pelvis consists basically of three parts: (*a*) stereoroentgenographic examination of the inlet; (*b*) roentgen examination of the outlet; (*c*) lateral roentgen examination with centimeter measurement of the true conjugate. Minor modifications involving all three parts are presented.

(*a*) In order to adjust the normal plane of the pelvic inlet so that it will coincide with the plane of the film, which is essential for accurate studies, Caldwell and Moloy used a lumbosacral pad. This the author replaces with an angle block which he has described in an earlier contribution. (Am. J. Obst. & Gynec. **43:** 140, 1942).

(*b*) The author has also conceived of the application of stereoroentgenography to the study of the pelvic outlet. He describes the procedure as follows. "With the patient placed in a supine posture on the roentgenographic table, the superior border of the symphysis pubis is oriented on the Potter-Bucky diaphragm so that it coincides with the caudal edge of a 10 × 12 cassette, the short axis of which is in the median plane. The tube is angulated 45 degrees cephalad and the central ray is projected through the localization point (a point 5 cm. caudad to the superior border of the symphysis pubis) to the film. The roentgen tube is shifted transversely for the stereoroentgenograms.

(*c*) Finally, mention is made of the adoption of a thin rule of light weight for measurement of the true conjugate on the roentgenogram. This has been described by Perlberg (Am. J. Roentgenol. **45:** 935, 1941).

Fallopian Tube Visualization as a Treatment for Sterility. C. L. Martin. Am. J. Roentgenol. **47:** 894–901, June 1942.

According to various authorities, tubal obstruction is responsible for one-fourth to two-thirds of all cases of female sterility. Various technics for examination of the tubes roentgenologically have been introduced from time to time, including gas insufflation and lipiodol injection. With the use of these, it early became evident that they were in themselves frequently adequate to establish patency. The author uses a combined technic, first introducing carbon dioxide gas and, when obstruction is demonstrated, injecting lipiodol. In 101 women thus treated he has experienced no mishaps. He points out, however, that cases must be selected with some care. Acute and subacute pelvic inflammations and recent curettage are mentioned as the chief contraindications.

Patency of at least one tube was established in 75 of the 101 cases treated and subsequent conception occurred in 27. In 20 of this number patency was established with a single treatment; two tests were performed in 4 patients, and three tests in 3 others. The ultimate success obtained where multiple examinations were done suggests that the results might have been improved if more patients had submitted themselves to repeated examinations. The records of others both with gas insufflation and lipiodol are presented for comparison.

Anencephalus (with Acute Hydramnios) Diagnosed by X-Ray. W. R. Payne and H. G. Bland. Am. J. Obst. & Gynec. **44:** 593–594, October 1942.

Two cases of anencephaly diagnosed roentgenologically in the eighth month of pregnancy are reported. In the first patient x-ray examination was done because of an irregular mass deep in the pelvis and the presence of acute hydramnios. In the second patient, also, there was an acute hydramnios and no presenting part could be felt on vaginal examination.

Reference is made to Harbeson's review of the literature in 1938 (Canadian M. A. J. **38:** 574–575, 1938) and to 5 cases since reported.

THE GENITO-URINARY TRACT

Dissolution of Phosphatic Urinary Calculi by the Retrograde Introduction of a Citrate Solution Containing Magnesium. H. I. Suby and F. Albright. New England J. Med. **228:** 81–91, Jan. 21, 1943.

Previous experience demonstrated the dissolution of phosphatic renal stones by the action of isotonic citrate solution at a *p*H of 4.0. Because of bladder irritation by this solution various other solvents were tried, but none was found as effective. It was discovered, however, that by the addition of magnesium ions the citrate solution became less irritating and it

was once more accepted for clinical use. The present solution is of the following formula:

Citric acid (monohydrated)	32.25 gm.
Magnesium oxide (anhydrous)	3.84 gm.
Sodium carbonate (anhydrous)	4.37 gm.
Water	q. s. ad 1000 c.c.

The procedure consists in keeping the stone constantly bathed in the citrate solution by means of a specially designed apparatus that maintains constant fluid pressure when connected with a ureteral catheter or nephrostomy tube. Two-way drainage is desirable, rather than tidal drainage. Evaluation of results is obtained by air pyelograms.

One prerequisite to the procedure is to determine that one is dealing with a phosphatic stone. The history, chemical analysis of stones previously passed, and the roentgenologic appearance will be of great help in this respect.

Seven complete case histories are presented, demonstrating the method of application, some limitations, and the results in dissolution of phosphatic renal calculi. Reproductions of roentgenograms accompany the reports. JOHN B. MCANENY, M.D.

SINUS TRACTS AND FISTULAE

Radiological Exploration of Sinus Tracts, Fistulae and Infected Cavities. H. C. Gage and E. R. Williams. Brit. J. Radiol. **16:** 8–21, January 1943.

Successful investigation of sinus tracts with opaque contrast media requires a high grade of technical skill. Each case should be regarded as an individual problem. The injection of the medium should be performed by the radiologist himself, who should first take a careful history and examine the area to be injected. Preliminary x-ray studies should be made. Most injections are best performed under fluoroscopic control. Iodized oil is the best medium. Injecting the oil enables the operator to correlate the visual changes with the pressure changes, and also to elect the most advantageous time to make film records.

Sinus tracts may be divided into two classes, closed limited tracts, such as arise from an infected bone focus, and open unlimited tracts, communicating with a large cavity. The former are better filled completely. Those with a large cavity are better observed if they are only partially filled and roentgenograms are made in various positions. Fistulous tracts should be filled, but when the oil enters the viscus the injection should be stopped.

A continuous column of opaque medium should be maintained. The pressure, therefore, should not be intermittent. If screen control is not possible, fractional injections may be used and frequent roentgenograms made. In this event large films should be used, as the tract may extend much farther from its opening than is anticipated. Roentgenograms in two positions at right angles are minimum requirements. Sometimes oblique and stereoscopic views are indicated. A tilting fluoroscopic table is not necessary except in cases with large cavities, where changes in position are necessary, as in exploring pleural cavities. As it is usually inadvisable and inexpedient to move the patient, if a biplane apparatus is not available a portable unit may be used for one view.

The author uses a Record syringe fitted with a urethral syringe tip. This is more satisfactory than the usual urethral syringe, as the pressure may be more easily regulated. Soft rubber catheters are useful in some situations. In sinuses with pin-point openings where a metallic catheter is useful, a lacrimal duct cannula is convenient.

No extraneous oil should be permitted on the surface. If there are several openings to the sinus, all but the one used for the injection should be closed with a small collodion dressing.

It is frequently useful to mark surface landmarks with opaque rings or numbers.

If a fistula is suspected of entering the small intestine, a combination of barium by mouth and oil injection is advantageous. The use of half-strength opaque enemata in conjunction with oil injection in cases of fistulae connected with the colon is of great aid.

[This excellent article, including seventeen case reports and the original illustrations, is to be reprinted in full in the September issue of RADIOLOGY].

SYDNEY J. HAWLEY, M.D.

RADIOTHERAPY

MALIGNANT NEOPLASMS

Method of Treatment for Carcinoma of the Breast, Including the Forequarter. C. W. S. Jerram and W. A. Langmead. Brit. J. Radiol. **16:** 26–29, January 1943.

The method described here for treatment of mammary carcinoma consists in irradiation of five fields around the forequarter (pectoral region, axilla, and scapula) with the tube angulated slightly outward, so that the volume of tissue treated forms a five-sided pyramid, the base of which runs from the sternum to the scapula. With this method, it is claimed, a more uniform amount of radiation can be given to this volume of tissue, it is possible to give a higher total dose in a reasonable time, and the technic is standard and can be reproduced at any time. A minimum amount of lung is irradiated.

A five-sided wood frame is used as a guide in setting up treatment areas. This gives one sternal, and one scapular area, one supraclavicular, one inframamillary, and one axillary field. The tube is adjusted, then angulated outward about seven degrees, and the frame is removed. Inequalities of the surface are compensated for by the addition of rice bags.

Two fields are usually treated a day, each receiving 300 to 400 r; 3,000 to 3,500 r throughout the pentagon are given in twenty-eight days.

The disadvantages of the method are, briefly, as follows. (1) The supraclavicular field is often difficult to set up when the neck cannot be extended to allow angulation of the tube. In this case, the uniformity of dosage is not affected, but the lung receives greater irradiation. (2) Sometimes in the scapular field the beam is applied too far laterally, so that not enough of the posterior part of the axilla is irradiated. In this case the tube is deliberately brought nearer the mid-

line than the rigid pentagon will allow. (3) The pentagonal area does not always cover the lower portion of the scar in a postoperative case. In this event an extra area over the scar is added. (4) A second treatment with the pentagonal method is excluded by the high dosage level reached.

Since the purpose of the article is to present the method, few clinical data are recorded. It has been used in 39 cases in the past two and a half years.

SYDNEY J. HAWLEY, M.D.

Uses and Abuses of Radiation Therapy in Obstetrics and Gynecology. H. F. Traut. Am. J. Obst. & Gynec. **44:** 638–647, October 1942.

This paper deals with the indications and contraindications for radiation therapy in the field of gynecology, the subject being considered from the point of view of the age period.

In the pre- and post-puberal period (first and second decades) the author believes that, with the rare exception of malignant neoplasms of the genital tract, there is seldom any justifiable gynecologic indication for radiation therapy. So-called "stimulating" and "temporary castrating" doses of x-rays or radium for menstrual irregularities are often ineffectual and may be permanently damaging. Until much more accurate knowledge is available such measures should be used only in the most unusual circumstances.

In the reproductive period (third and fourth decades) the desirability of preserving the procreative function is a determining factor. Any form of treatment directed toward the cure of an ill which, at the same time, precludes the possibility of childbearing, can be justified only when the dangers inherent in the disease are of such a magnitude as to fully warrant castration. The treatment of carcinoma of the cervix constitutes the greatest use which can be made of radiation during the reproductive period of life. That it has been a great aid and that it is the best mode of therapy in all stages of this disease, excepting the very earliest, is unquestionable. Radiation castration may also be indicated in carcinoma of the breast and in endometriosis. Myomas, the author believes, are at this age best treated by surgery.

As the menopause is approached and the desirability or possibility of childbearing has largely or completely passed, that is, in women forty or more years of age, the indications for the use of radium and x-ray in the treatment of benign conditions increase. Hyperplasia of the endometrium when it does not yield to curettage or hormonal treatment, endometriosis, the submucous myoma which produces excessive blood loss, and adenomyoma all may be treated efficiently and with the obviation of laparotomy by means of radiation. Treatment of pruritus of the vulva and anal region by roentgen rays should be given, however, with the greatest caution because of the danger of cutaneous changes. Vulvar carcinoma should never be irradiated.

In this period, as in the reproductive period, cervical cancer constitutes the chief indication for irradiation. In this connection the author urges the importance of semi-annual gynecologic examinations in order that early treatment may be instituted.

In the aged radiation therapy may be of great palliative benefit, but on the other hand it may bring added suffering in the form of nausea, vomiting, and pain. The author deplores its use in extensive metastatic disease.

Diagnosis and Treatment of Carcinoma of the Corpus Uteri Based on Experiences at the Woman's Hospital. G. G. Ward. Am. J. Obst. & Gynec. **44:** 303–309, August 1942.

The series of corpus carcinomas forming the basis of this report numbers 192, observed between 1919 and 1941 in the Woman's Hospital, New York; 142 were seen between 1919 and 1935, and on these the authors' five-year end-results are computed.

The ideal treatment for carcinoma of the corpus is a prompt total hysterectomy with salpingo-oophorectomy. As a preliminary diagnostic curettage is usually necessary, intracavitary irradiation should be initiated at that time to render the tumor cells inactive. At the Woman's Hospital two 50-mg. capsules of radium element in tandem formation, with 1 mm. of platinum and rubber screening, are inserted to the fundus and anchored by suture through the cervix and vulva. The curettings are sent to the laboratory for a six-hour report (paraffin section) and if the diagnosis is "malignant" the radium is left in place for a dose of 2,400 to 4,000 mg. hours. Four to six weeks later hysterectomy and bilateral salpingo-oophorectomy are done. Operation is followed, after convalescence is established, by a series of deep x-ray therapy according to the Coutard technic. In a considerable number of patients operation is contraindicated by senility, obesity, cardiovascular disease, renal insufficiency, diabetes, or the extent of the neoplastic disease. In such cases repeated intra-uterine irradiation is advisable—2,400 to 4,000 mg. hours at four-week intervals—preceded or followed, when feasible, by deep x-ray therapy.

Of the 142 patients seen up to the end of 1935, 63 lived five years or longer, an absolute survival rate of 44.4 per cent. Since 9 patients were untreated, the relative survival rate, based on 133 cases, is 47.4 per cent. Twenty-seven were treated by surgery alone, and of these 17 or 63 per cent lived five years; 69 were treated by irradiation alone, with 22 five-year survivals, or 32 per cent; 32 received both surgery and irradiation, with 24 five-year survivals, or 64.9 per cent. Only one patient was untraced and she is counted as dead. The primary operative mortality was 3.2 per cent.

The results of other workers are reviewed and references are given.

Radium Treatment of Cancer of the Bladder: Report of 267 Cases. C. C. Herger and H. R. Sauer. Am. J. Roentgenol. **47:** 909–915, June 1942.

The authors advocate interstitial radium irradiation, either alone or in combination with other therapeutic methods, in properly selected cases of carcinoma of the bladder. They report 267 cases out of a total of 445 seen in a ten-year period (Jan. 1, 1930–Dec. 31, 1939) in which radium implants were employed. Both papillary carcinomas and infiltrating solid carcinomas were treated. Tumors exceeding 5 cm. in diameter require excessive amounts of interstitial radium for their destruction and this is true also of multiple tumors. For this reason the authors avoid, whenever possible, implantation of radon when more than three tumors of 1 to 3 cm. in diameter are present. The location of the tumors is also to be taken into consideration. Le-

sions in or around the internal vesical orifice have a tendency to show more severe reactions than those at other sites. Papillary tumors are in general more radiosensitive than the solid infiltrating growths. Except in rare instances, good results have been obtained only when solid tumors did not exceed 3 or 4 cm. in diameter.

Only 52 cases in this series were considered suitable for immediate interstitial therapy. In the remainder preliminary treatment with roentgen rays or electrocoagulation, or both, was employed to reduce the size or number of the tumors. The best results of such measures were obtained in papillary tumors. After the full benefit of the preliminary treatment had been achieved, usually after six to eight weeks, radon implantation was carried out. In the majority of cases implantation through the cystoscope was preferred to the suprapubic approach. In a limited number of female patients radium element radiation was used. Tables are included showing the number of millicuries and milligram-hours required with radon seeds and radium needles, respectively, to deliver various doses to the tumor.

The most common reaction observed in this series was ulceration at the implantation site. This occurred in 197 cases, or 73.7 per cent of the 207 cases treated. Healing took place in 106, but in the remaining 91 ulceration persisted.

The five-year results of treatment are summarized as follows:

"The total number of living patients in whom the bladder is free of tumor is 97 (36.3 per cent) of 267 cases. Thirty-five of these have been well for more than five years. Since 119 patients were treated during the period from 1930 to 1934, the percentage of five-year cures amounts to 28.6. Twenty-eight patients with five-year cures had papillary carcinoma and 7 had non-papillary tumors. This makes a total of 33.3 per cent cures for the papillary and 21.9 per cent for the non-papillary carcinomas."

Methods and Effects of Preoperative Irradiation in Treatment of Osteogenic Sarcoma. N. L. Higinbotham and B. L. Coley. Am. J. Roentgenol. **47:** 902–907, June 1942.

The authors analyze a series of 69 proved cases of osteogenic sarcoma seen in the bone tumor department of Memorial Hospital (New York) in which preoperative radiotherapy was used. For the most part the fractionated dose technic was employed: at 200 kv. in 44 cases, at 250 kv. in 15 cases, and at 1,000 kv. in 3 cases. In 9 cases the 4-gram radium element pack was used, and in 2 cases the massive dose technic with roentgen rays. The program of irradiation in these cases must be arranged to meet individual requirements, and kilovoltage, daily dosage, and size of portals must be balanced against the size of the tumor, estimated skin tolerance, and a proposed total tissue dosage of at least 4,000 r. All these points the authors discuss in some detail.

Because of the necessity of delivering an adequate tumor dose, the skin reaction may be severe, though the dose per portal should not exceed the limits of skin tolerance. Usually two to six weeks must be allowed for healing before amputation is undertaken.

The osteogenic sarcomas vary widely in radiosensitivity and the effect of radiation on the rate of growth is consequently variable. Sarcomas in adults are apt to be radioresistant, and in most such cases early amputation without preoperative irradiation is indicated.

Pathologic studies cannot be relied upon as an indication of complete sterilization of the tumor, but in 16 cases of the authors' series microscopic studies showed evidence of a favorable radiation effect. The best results were observed with the higher voltages and following the use of pre-irradiation diathermy.

In patients with an initial elevated serum phosphatase, estimations of phosphatase activity afford a reliable index of the inactivation of the tumor. In 18 cases studied with this in view, there was a drop from an initial average of 18.5 units to an average of 9.2 units after irradiation and to a normal of 5.6 units following amputation.

In practically all cases there was relief of pain with a consequent decrease of disability.

Clinical Experience with Radio-Phosphorus in the Treatment of Certain Blood Dyscrasias. T. Fitz-Hugh, Jr., and P. J. Hodes. Am. J. M. Sc. **204:** 662–665, November 1942.

Radioactive phosphorus produced by the Berkeley cyclotron was used to treat 38 patients with polycythemia vera, chronic myelogenous leukemia, chronic lymphatic leukemia, acute leukemia, Hodgkin's disease, multiple myeloma, reticulo-endotheliosis, reticulum-cell sarcoma, or metastatic cancer.

The material, in solution, may be administered orally in single doses varying from 1 to 20 mc. or intravenously in doses varying from 0.2 to 2.0 mc. Small doses to test tolerance are given at first. The frequency of administration follows no set rule. Usually repeated small doses are preferable to a single large one. The total dosage varies according to the hematologic and clinical status and the response of the patient. No severe reactions have been observed following treatment.

Of 8 patients with polycythemia vera, 4 were markedly improved. Two showed hematologic relapse after six and seven months. Improvement may begin early, but full hematologic effect is rarely obtained until treatment has been carried out for two or three months.

One of 5 patients with chronic myelogenous leukemia obtained an excellent remission; 3 were unimproved, and 1 is responding satisfactorily. Two of 4 patients with chronic lymphatic leukemia obtained good remission. None of the cases of acute leukemia was benefited.

One patient with Hodgkin's disease, of 5 treated, who was x-ray-therapy-fast was considerably improved. One patient with a huge mediastinal mass did not respond to radiophosphorus but did show regression with x-ray therapy.

Of 6 patients with lymphosarcoma, 2 obtained good remissions and 2 were moderately benefited. A patient with reticulo-endotheliosis improved remarkably, despite unsatisfactory response to moderate x-ray therapy.

Two patients with extensive gallbladder carcinoma, one with metastatic mammary carcinoma, and one each with multiple myeloma and reticulum-cell sarcoma did not benefit from radiophosphorus.

BENJAMIN COPLEMAN, M.D.

NON-NEOPLASTIC DISEASE

Treatment of Wounds and Inflammation by X-rays and Radium Rays. N. S. Finzi and F. Freund. Brit. M. J. **1:** 34–36, Jan. 9, 1943.

The authors open this interesting article with the statement that x-ray and other radiation in the treatment of wounds and inflammations is much neglected. The causes of the neglect are various. Among those mentioned are the universality of the indications, which causes suspicion, the overshadowing of this field by the use of radiation in malignant neoplasms, and finally the frequent use of incorrect dosage. A list of the conditions treated with great success is given.

In a discussion of the basis of treatment the following points are mentioned: first, acceleration of healing in clean wounds; second, a checking of local inflammation. The value of small doses is referred to rather pointedly. The action which follows is described as acceleration of healing; the reverse occurs when too large a dose is given. Some explanatory evidence for different hypotheses is presented. The following conditions are discussed as meriting the use of radiation: delay in natural healing of soft tissues or bones; failure of surgical or medical treatment in osteomyelitis; acute inflammations, such as carbuncle of the upper lip; subacute and chronic inflammations. The action preventing scar formation is also discussed.

Regarding dosage, the statement is made that wavelength is not of any great importance provided the proper biological dose is given, namely, between 30 and 80 r applied twice or once per week. A small aluminum filter is advised. Acute cases require smaller doses. The effect of radiation is attributed to its influence on local cellular reaction and local immunity.

Q. B. CORAY, M.D.

Roentgen Therapy of Pruritus Ani. T. S. Saunders. Urol. & Cutan. Rev. **47:** 49–50, January 1943.

The author reports on 30 cases of pruritus ani which were treated by roentgen therapy. Twenty-eight of these cases were treated between 1937 and 1942.

There were 19 males and 11 females; the ages varied from 21 to 57 years, the average being 38.8 years. Duration of symptoms ranged from two months to twelve and a half years. Itching was the cardinal complaint. Forty-six per cent of the patients had concomitant skin diseases. Local examination of 12 patients was negative. Topical medication was tried in 23 cases without appreciable improvement.

The following factors were used in x-ray therapy: 87 kv., 4 ma., half-value layer 0.84 mm. Al. The average dose given was 495 r. The lowest dose was 75 r; the largest, 2250 r. The average number of treatments per patient was 4.8. The time interval between treatments is not given. In no case did an erythema develop, although hyperpigmentation was seen in several. Of the 30 patients treated, 22 were relieved, 2 showed slight relief, and 6 no relief.

MAURICE D. SACHS, M.D.

Results of Treatment of Acne Vulgaris by X-Rays and Other Physical Methods. L. M. Smith. Texas J. Med. **38:** 512–513, December 1942.

X-ray treatment has a more or less specific effect on the local pathologic changes in and about the sebaceous glands. It diminishes the excessive glandular activity and the intrafollicular hyperkeratosis as well as stimulating the resolution of the chronic pseudogranulomatous infiltration about the pilosebaceous apparatus.

Of 169 cases of acne vulgaris in which x-rays were employed, 130, or 70 per cent, showed a satisfactory final result; 23, or 18 per cent, were greatly improved; 16, or 12 per cent, were only slightly improved or not at all. Of 100 patients sixteen years of age or older, 89 per cent were finally cured. Younger patients, consequently, are least responsive to x-ray treatment.

The fractional method with unfiltered radiation was generally employed. The usual dosage was 75 r (1/4 skin unit) once weekly for twelve to fourteen doses.

The author has not seen any cures of acne vulgaris with ultraviolet irradiation. Its use has been limited, however, to cases not considered suitable for x-rays, to short periods of treatment between x-ray courses, to patients having received the safe limit of x-rays, and as a follow-up treatment to hasten resolution of the slight discolored infiltration remaining from healed lesions.

Deep indurated lesions are often improved by mild freezing with carbon dioxide slush, sufficient to cause some desquamation, but not blistering.

STEPHEN N. TAGER, M.D.

Shock-Proof Roentgen Ray Apparatus in Dermatology. G. M. MacKee, A. C. Cipollaro, and A. Mutscheller. Arch. Dermat. & Syph. **47:** 43–57, January 1943.

Experiments were conducted by the authors to determine the difference in quality of radiation between the Coolidge and modern shock-proof tube.

With 100 kv., with no filter, the tubes had the following half-value layers: thin-walled, soft glass, Universal Coolidge tube (old type), 0.26 mm. Al; Universal Coolidge tube of pyrex glass, 0.88 mm. Al.; shock-proof tube installed in the authors' clinic, 0.80 mm. Al. These findings disprove the general opinion that the quality of the rays from a shock-proof apparatus is approximately the same as of those from a Coolidge tube with 0.5 mm. Al added.

It was found that in the Coolidge tube, which has a round focal spot and a 45° angle target, the distribution of x-rays was uniform and followed the inverse square law. It is therefore possible to calculate the amount of radiation falling on a point a given distance from the center. With the shock-proof tube the field of distribution is not uniform, and is lowest in the region of the anode, the so-called heel effect. It was brought out in the discussion that the heel effect is greater in the shock-proof type of tube because the angle of the target is only 20 to 30 degrees instead of 45° as in the Coolidge tube. Another cause for the unequal distribution of rays is the difference in thickness in the layer of oil through which they pass.

The shock-proof tubes are much more flexible to use, and because of the safety factor contact therapy can be simulated without special apparatus.

The biologic effect of irradiation from the shock-proof tube is thought to be about the same as that from the Coolidge tube. The authors use 300 r of unfiltered radiation as an erythema dose. For filtered radiation at 120 to 140 kv. and 0.5 mm. Al, they recommend that 400 r be used as an erythema dose; with 1 mm. Al 450 r, and with 3 mm. Al 550 r.

JOSEPH T. DANZER, M.D.

RADIATION EFFECTS

Post-Radiation Panmyelophthisis Clinically Simulating Agranulocytosis. J. L. Sims and M. L. Carns. Ann. Int. Med. **17:** 1021–1028, December 1942.

A 43-year-old white female complained of an abdominal mass and progressive weight loss (60 pounds) for the past seven months. Physical examination revealed enlarged, firm lymph nodes in the cervical, axillary, and inguinal regions, with multiple fixed intra-abdominal masses. From an inguinal lymph node, a biopsy diagnosis of lymphosarcoma was made.

Roentgen therapy was instituted. With one-fourth of the body surface exposed at a time, a dose of 50 r was given twice to each area in turn. Then 200 r were given to each of three abdominal preaortic node areas and to the splenic area. No more than one area was treated each day. Three weeks later, the white blood count was 6,900, falling abruptly two days after this to 950. Irradiation was immediately stopped.

Despite intensive therapy with pentnucleotide, intramuscular liver extract, and three transfusions of 500 c.c., no benefit was experienced. The total leukocyte count steadily decreased, reaching a final low, twenty-two days after irradiation was begun, of 75 (94 per cent lymphocytes; 4 per cent blasts; 2 per cent unclassified). Death occurred the following day.

None of the drugs given (nembutal, aspirin, nicotinic acid, ephedrine sulfate, and scopolamine) could be considered a cause of agranulocytosis.

At necropsy, the mediastinal nodes were found to form a large, firm irregular mass. Matted masses of lymph nodes were present in the retroperitoneal and pelvic areas, and in the mesentery. Bone marrow from ribs, sternum, vertebrae, and femurs showed erythropoietic and myelopoietic centers to be few and relatively inactive, with many showing distinct necrosis. This amounted to almost a complete aplasia of all the hemopoietic elements.

Search of the literature failed to reveal any clear-cut, fully reported case of pure agranulocytosis secondary to irradiation. The authors conclude by suggesting that what seems to be a severe uncomplicated neutropenia is actually a manifestation of a generalized marrow damage. STEPHEN N. TAGER, M.D.

Non-Carcinomatous Postirradiation Ulcerations of the Cervix. H. W. Jacox, J. R. Johnston, and P. Gross. Pennsylvania M. J. **46:** 119–121, November 1942.

Post-irradiation ulcerations of the cervix, vagina, bladder, and rectum may occur months or years after irradiation therapy. The authors discuss 4 cases of ulceration in a series of 99 patients. These post-irradiation ulcerations, caused by vascular occlusive changes, can be differentiated from carcinoma only by microscopic examination.

JOSEPH T. DANZER, M.D.

Prevention of Irradiation Sickness: Use of Vitamin B_1 in Roentgen Therapy. W. H. Whitmore. Am. J. Roentgenol. **49:** 83–98, January 1943.

A review is given of the various theories regarding the cause of roentgen or irradiation sickness and of the treatments which have been proposed and tried. This sickness, in its severe form, is not of very frequent occurrence, but is most likely to develop in those who are least able to withstand its effects, that is, in patients undergoing treatment for cancer. Frequently the treatment of the disease by radium or roentgen rays has had to be suspended or modified on account of the severe constitutional symptoms of irradiation sickness. The sedative drugs, nembutal, luminal, codeine and morphine, may give some relief but they increase the anorexia, resulting in increased weakness and loss of weight. Dehydration may be a factor also in increasing the debility. The report of Martin and Moursund (Am. J. Roentgenol. **38:** 620–624, 1937) suggested that the undesirable and unfavorable effects of irradiation might be minimized or relieved by the administration of vitamin B_1.

Beginning in October 1938, a series of patients undergoing treatment with 200-kv. roentgen rays were given thiamin chloride, synthetic vitamin B_1, in addition to other supportive and stimulative measures. In most of the pelvic and abdominal cases, a pyramidal roentgen dose technic was used, starting with 100 r to each of two fields daily and increasing the amount of radiation each fourth day up to 500 r or more daily. This allowed time for the effect of the vitamin B_1 before the larger amounts of radiation were delivered.

One hundred and twenty-two patients were given thiamin, some receiving, also, concentrated liver extract (0.5 c.c. doses, intramuscularly, three times weekly in more than two-thirds of the cases) and calcium salts (the compound of calcium gluconate and dicalcium phosphate, 1 gram three times daily) during the period of roentgen therapy. These patients received treatment over fairly large areas of the neck, thorax, abdomen and pelvis. Of those given 6 mg. or more of thiamin chloride daily, 79.8 per cent had no symptoms of irradiation sickness. Nine patients were given more than 9 mg. of thiamin daily and none of these had symptoms of irradiation sickness.

On the basis of the similarity of the symptoms of vitamin B_1 deficiency and those of irradiation sickness and the clinical results of vitamin B_1 administration in irradiation sickness, it is suggested that this vitamin is required to metabolize the products of nuclear disintegration, or other substances produced in the body by irradiation, and that when it is present in adequate amount in the body, irradiation sickness does not develop. CLARENCE E. WEAVER, M.D.

Effects of Radiation on Workers. R. Paterson. Brit. J. Radiol. **16:** 3–5, January 1943.

The late effects of radiation on workers are of three types: (1) development of warty growths on the hands; (2) a lethal type of anemia; (3) development of tumors in the body itself.

Warty growths on the hands are due to excessive local exposure. There is controversy over the cause of the anemia. It may be the result of prolonged exposure to gamma rays or short x-rays. The statement has been made that it does not occur from exposure to longer x-rays. Tumor growths, particularly in the bones and lungs, are the result of ingestion or aspiration of radium.

Many of these effects may be latent for long periods. When they have developed, there is usually nothing

that can be accomplished by treatment. Prevention is therefore of greatest importance.

The earliest observed changes due to local exposure are erythema and glossiness of the skin, frequently accompanied by tingling. The nails become brittle. At the development of these symptoms, the worker should change occupation. If working conditions are not safe, they may be corrected, and the victim may then safely continue work. When exposure is stopped in this stage, the symptoms subside and there is rarely further trouble.

The earliest blood changes occur in the white cells. There is a slight diminution in the total white count and a relative decrease in the neutrophils. Different persons show different degrees of sensitivity to irradiation. Blood counts should be done frequently. At the first sign of persistent changes in the count, the worker should change jobs, or working conditions should be corrected. In institutions where large numbers of workers are exposed, it is not necessary to have blood counts on every worker. Small samples may be used; if these show changes a general survey should be instituted. The average normal white count is about 6,000.

Working conditions and apparatus should conform to the specifications of the British Protection Committee. Workers who receive local exposure should have regular inspections of the exposed parts by a competent observer. Workers who are exposed to general irradiation or inhalation or ingestion should have blood counts at least monthly.

Among the industrial processes entailing exposure to radiation the author mentions the work of so-called "radium luminizers" and high-voltage roentgenography of molds and castings.

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There is still dispute as to whether or not general irradiation by x-rays will produce blood changes. Blood counts should be carried out regularly on workers in radium or its products. The detection of early changes is not easy, as there is a wide variation in the normal white count, which ranges from 4,000 to 15,000. Persistent changes in the total count and the relative numbers of polymorphonuclear leukocytes and lymphocytes are of significance.

It would be useful to know whether or not short x-rays and gamma rays will produce these changes, as this would fundamentally affect the necessary protective measures.

Tests of the air in radium workshops show a concentration of about 10^{-11} curies per liter of radon. It is believed that to be safe the air should contain not more than 10^{-11} curies per liter.

To fix the standards of the safe amount of radium in the body is difficult. The amount of radon in the expired air varies, depending upon how long the radium has been ingested. If recently ingested, a concentration of 10^{-11} curies in the expired air indicates 1.3 micrograms in the body, of which 0.04 microgram will remain fixed. If the radium has been ingested over a period of years, the same concentration indicates 3 to 8 micrograms, all of which remains fixed. It should be remembered that an unexposed person of average weight will have a content of about 0.015 microgram.

If, after two or three days away from exposure, the expired air of a worker contains over 10^{-11} curies per liter, it is evidence of ingestion and the worker should discontinue this kind of work.

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